STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
D. H. BLOOD, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY — State Mineralogist

San Francisco] BULLETIN No. 107 [August, 1932

CALIFORNIA MINERAL PRODUCTION

AND

DIRECTORY OF MINERAL PRODUCERS

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By
HENRY H. SYMONS

CALIFORNIA STATE PRINTING OFFICE
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LETTER OF TRANSMITTAL

August, 1932.

To His Excellency, The Honorable James Rolph, Jr.,
Governor of the State of California.

Sir: I have the honor to herewith transmit Bulletin No. 107 of the State Division of Mines, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

Walter W. Bradley,
State Mineralogist.

INTRODUCTION

It is the endeavor of the staff of the State Division of Mines (formerly State Mining Bureau), in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our State, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the cooperation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January will result in earlier completion of the manuscript. Statistics lose much of their value if their publication is unnecessarily delayed.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

WALTER W. BRADLEY,
State Mineralogist.

MINERAL INDUSTRY, CALIFORNIA, 1931

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE DIVISION OF MINES, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA

CHAPTER ONE

The total value for the mineral output for California for the year 1931 was $215,964,420, being a decrease of $149,640,275 from the total of 1930 of $365,604,695. There were fifty-three different mineral substances exclusive of a segregation of the various stones grouped under gems; and all but one of the fifty-eight counties of the State contributed to the list.

As revealed by the data following, the salient features of 1931 compared with the previous year were: A material decline in the amount and value of the petroleum output, with notable decreases in amounts and values of natural gas, miscellaneous stone, cement, copper, brick, and hollow building tile; and potash. Increases were registered by gold, borax, limestone and salt. Petroleum showed a decrease in value of $129,863,323. There was a decrease from 227,328,988 barrels to 188,270,605 barrels. This decrease was partly due to a curtailment program and extremely low prices paid for the lighter-gravity crude oils. Natural gas showed an increased output with a decreased value from 315,513,952 M cu. ft. worth $24,559,840 to 344,959,920 M cu. ft. worth $16,690,695.

Of the metals the gold yield increased in value from a total of $9,451,162 to $10,814,162, and platinum from 217 fine oz. worth $11,700 to 350 fine oz. worth $11,979. Decreased values were registered by all other metals, copper from 26,534,752 lbs. worth $3,449,552 to 12,954,842 lbs. worth $1,178,890; quicksilver from 11,374 flasks worth $1,255,257 to 13,478 flasks worth $1,121,624; silver from 1,622,803 fine oz. worth $624,779 to 867,818 fine oz. worth $251,667; and lead from 3,524,796 lbs. worth $176,241 to 3,934,240 lbs. worth $145,568. A small amount of zinc was mined commercially for the first time since 1927. The increase in the gold output was due to increased activity in both lode and placer mines. All metals other than gold reached prices so low it would not pay to mine them.

Of the structural materials, all items showed decreased values with the exception of chromite and bituminous rock; cement decreased from 9,831,938 bbls. worth $14,575,731 to 7,693,712 bbls. worth $11,510,655; brick and hollow building tile from a total value of $4,205,460 to

$2,560,415; miscellaneous stone $16,430,027 to $11,848,531 and granite from $855,477 to $636,741.

Of the industrial materials the total value decreased from $7,168,522 to $4,741,939; increases in value of annual productions were registered by barytes, bentonite (fullers earth), feldspar, gems, limestone, and silica; while all other minerals in the group showed a decreased value. The salines were the only group that showed an increase in total value, being from $9,943,500 to $11,779,513. Producers received more for salt and borates than they did in 1930, and iodine was added to the group which more than offset the decrease in all other materials under this classification.

The figures of the State Division of Mines are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields, commercially, a greater number and variety of mineral products than any State in the United States, and probably more than any other equal area elsewhere on the earth. The total annual value of her output has been surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. More recently California has been placed second to Pennsylvania, the leader. California for many years was the sole domestic source of borax and chromite, and in which we still lead. We lead all other states in the production of gold, quicksilver, platinum, diatomite, silica, potash and soda; and have alternated in the lead with Colorado and Nevada in tungsten; with Washington in magnesite; and with Oklahoma and Texas in petroleum.

The mineral industries, not only in California but throughout the country, have reached quite a different phase from that of the old gold-rush days more than fifty years ago. A broader and more intimate status has been attained, touching practically every avenue of domestic and commercial endeavor. As quoted in a former report[1] of the freight handled by the railroads of the country, the products of the mines represent 51.33 per cent. While gold, in which California still leads the United States, is still important, other metals and even non-metals have superseded it in annual value. The greatest commercial developments proportionately in California in recent years have taken place among the industrial and structural minerals, not to mention petroleum, which leads all others in value. This introduces a new factor which requires study and attention—that of marketing. The gold miner could, and still does, take his metal to the mint and receive its equivalent in the 'coin of the realm'; and he knows from day to day and year to year, without variation, just how much each ounce of gold will bring in that coin, though its equivalent in other commodities varies according to economic conditions. Marketing and competition, however, are vital factors in the industrial and structural groups.

[1] Cal. State Min. Bur., Bulletin 96, p. 12, 1925.

By Substances.

The following table shows the comparative yield of mineral substances of California for 1930 and 1931, as compiled from the returns received at the State Division of Mines, San Francisco, in answer to inquiry sent to producers:

Substance	1930		1931		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Barytes	19,783 tons	$133,107	27,682 tons	$156,647	$23,540+
Bituminous rock	8,525 tons	36,075	*	*	*+
Borates	209,869 tons	3,686,817	206,405 tons	5,753,037	2,066,220+
Brick and hollow building tile		4,205,460		2,560,415	1,645,045—
Bentonite (fuller's earth)	12,522 tons	177,964	13,960 tons	222,583	44,619+
Cement	9,831,938 bbls.	14,575,731	7,693,712 bbls.	11,510,655	3,065,076—
Chromite	80 tons	1,905	441 tons	6,737	4,832+
Clay (pottery)	938,586 tons	795,517	332,680 tons	408,931	386,586—
Coal	10,885 tons	59,858	12,551 tons	77,607	17,749+
Copper	26,534,752 lbs.	3,449,522	12,954,842 lbs.	1,178,890	2,270,632—
Dolomite	35,721 tons	106,813	*	*	*—
Feldspar	5,014 tons	35,654	4,795 tons	59,921	24,267+
Gems		3,540		5,607	2,067+
Gold		9,451,162		10,814,162	1,363,000+
Granite		855,477		636,741	218,736—
Gypsum	116,865 tons	243,507	88,354 tons	199,198	44,309—
Lead	3,524,796 lbs.	176,241	3,934,240 lbs.	145,568	30,673—
Lime	47,662 tons	452,084	36,189 tons	360,523	91,561—
Limestone	169,477 tons	508,751	177,268 tons	560,699	51,948+
Magnesite	38,681 tons	388,472	21,576 tons	182,283	206,189—
Marble[a]		82,194		81,760	434—
Mineral water	37,354,111 gals.	2,870,663	26,164,331 gals.	1,347,860	1,522,803—
Natural gas	315,513,952M cu.ft.	24,559,840	344,959,920M cu.ft.	16,690,695	7,869,145—
Petroleum	227,328,988 bbls.	271,699,046	188,310,605 bbls.	141,835,723	129,863,323—
Platinum	217 fine oz.	[d]11,700	350 oz.	11,979	279+
Pumice and volcanic ash	12,974 tons	128,847	11,711 tons	108,130	20,717—
Pyrite	39,954 tons	194,228	25,402 tons	131,174	63,054—
Quicksilver	11,374 flasks	1,255,257	13,478 flasks	1,121,624	133,633—
Salt	347,948 tons	1,167,487	330,951 tons	1,233,567	66,080+
Sandstone		56,404		30,960	25,444—
Silica (sand and quartz)	17,802 tons	71,380	43,330 tons	182,769	111,389+
Silver	1,622,803 fine oz.	624,779	867,818 fine oz.	251,667	373,112—
Soapstone and talc	15,861 tons	154,258	13,472 tons	109,940	44,318—
Soda	90,122 tons	1,627,344	78,701 tons	1,217,811	409,533—
Stone, Miscellaneous[b]		16,430,027		11,848,531	4,581,496—
Zinc			149,865 lbs.	5,314	5,314+
Unapportioned		[c]5,327,584		[d]4,914,712	412,872—
Total values		$365,604,695		$215,964,420	
Net decrease					$149,640,275

* Included under 'Unapportioned.'

[a] Includes onyx and travertine.

[b] Includes macadam, crushed rock, ballast, rubble, riprap, sand and gravel.

[c] Includes asbestos, bromine, calcium chloride, diatomite, iron ore, magnesium salts, manganese ore, mineral paint, potash, slate, sillimanite-andalusite-cyanite group, tube-mill pebbles, sulphur, tungsten, paving blocks.

[d] Includes bituminous rock, bromine, calcium chloride, diatomite, dolomite, iodine, iron ore, manganese ore, mica, mineral paint, sillimanite-andalusite-cyanite group, potash, slate, tube-mill pebbles, paving blocks, sulphur, tungsten.

By Counties.

The following table shows the comparative value of the mineral production of the various counties in the State for the years 1930 and 1931:

County	1930	1931
Alameda	$2,529,337	$2,417,925
Alpine	2,500	29
Amador	2,424,687	2,170,075
Butte	539,666	482,737
Calaveras	2,083,956	1,093,554
Colusa	50,140	118,905
Contra Costa	1,643,286	1,328,812
Del Norte	176,030	38,075
Eldorado	493,243	437,935
Fresno	2,324,473	2,238,333
Glenn	61,179	47,462
Humboldt	270,633	199,986
Imperial	368,023	528,027
Inyo	2,260,766	1,347,708
Kern	42,987,977	28,782,358
Kings	13,106,843	17,371,901
Lake	268,364	280,768
Lassen	18,094	1,843
Los Angeles	171,616,329	79,469,897
Madera	675,782	488,343
Marin	405,541	544,760
Mariposa	143,465	193,641
Mendocino	123,062	72,707
Merced	801,900	707,789
Modoc	16,250	181,250
Mono	148,984	201,923
Monterey	452,974	223,470
Napa	532,983	396,841
Nevada	2,320,233	3,497,218
Orange	26,335,290	15,135,148
Placer	323,717	285,848
Plumas	3,219,900	1,559,296
Riverside	3,220,636	2,526,503
Sacramento	2,303,108	2,259,674
San Benito	1,389,490	654,284
San Bernardino	10,657,301	9,975,484
San Diego	1,303,047	852,447
San Francisco	23,428	20,500
San Joaquin	724,862	462,196
San Luis Obispo	248,115	400,135
San Mateo	2,499,937	2,230,509
Santa Barbara	24,368,374	12,714,760
Santa Clara	884,329	666,300
Santa Cruz	2,361,954	1,767,134
Shasta	1,111,146	666,086
Sierra	606,585	691,365
Siskiyou	235,401	187,007
Solano	46,638	62,270
Sonoma	330,399	252,636
Stanislaus	331,688	277,281
Sutter		
Tehama	226,400	50,407
Trinity	437,333	328,522
Tulare	253,144	197,116
Tuolumne	318,322	377,157
Ventura	31,952,052	15,455,727
Yolo	27,000	21,500
Yuba	1,018,399	1,022,826
Totals	$365,604,695	$215,964,420

Total Mineral Production of California, by Years, Since 1887.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau (now Division of Mines) began. At the side of these figures have been placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these have since declined, though silver, structural materials and copper increased in 1920–1924, also lead and magnesite in 1923; lead and zinc in 1925; zinc in 1926, with silver declining; an increase in quicksilver in 1927–1928, with declines in other metals and by petroleum. Natural gas has shown a steady increase since 1907, and in 1929 its value was second only to petroleum.

Total Mineral Production of California, by Years, Since 1887

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,409,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,989,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,683,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
1925	434,519,660	13,065,330	330,603,829
1926	450,330,856	11,923,481	345,546,677
1927	366,781,394	11,671,018	260,735,498
1928	332,224,233	10,785,315	229,998,680
1929	432,248,228	8,526,703	321,366,863
1930	365,604,695	9,451,162	271,699,046
1931	215,964,420	10,814,162	141,835,723
Totals	$6,068,069,302	$704,983,913	$3,784,930,415

CHAPTER TWO

FUELS

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up practically 73 per cent of the state's entire mineral output for the year 1931.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Comparison of values during 1930 and 1931 is shown in the following table:

Substance	1930		1931		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Coal	10,885 tons	$59,858	12,551 tons	$77,607	+$17,749
Natural gas	315,513,952 Mcu.ft.	24,559,840	344,959,920 Mcu.ft.	16,690,695	—7,869,145
Petroleum	227,328,988 bbls.	271,699,046	188,310,605 bbls.	141,835,723	—129,863,323
Total value		$296,318,744		$158,604,025	
Net decrease					$137,714,719

COAL

Bibliography: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXVIII (inc.), XXVI. U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; Ann. Rept. 22, Pt. III.

The coal production in California during 1931 totaled 12,551 short tons valued at $77,607 at the mine, and came from a single property in each: Amador, Monterey, Santa Cruz, and Trinity counties. The 1931 output showed an increase in both quantity and value over that of 1930, which was 10,885 short tons worth $59,858. This coal was consumed by the local market and also used on the property for camp purposes, power and forge, to carry on regular operations and development work.

Total Coal Production of California.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. Stone Canyon, Monterey County, was also an important producer for a short time, and there has been some coal shipped from properties in Amador, Fresno, Orange, Riverside, Siskiyou and Trinity counties. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value, by Years

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1898	143,045	$337,475
1862	23,400	134,550	1899	160,941	420,109
1863	43,200	248,400	1900	176,956	535,531
1864	50,700	291,525	1901	150,724	401,772
1865	60,530	348,048	1902	88,460	248,622
1866	84,020	483,115	1903	93,026	265,383
1867	124,690	716,968	1904	79,062	376,494
1868	143,676	826,137	1905	46,500	144,500
1869	157,234	904,096	1906	24,850	61,600
1870	141,890	815,868	1907	23,734	55,849
1871	152,493	876,835	1908	18,496	55,503
1872	190,859	1,097,439	1909	49,389	216,913
1873	186,611	1,073,013	1910	11,033	23,484
1874	215,352	1,238,274	1911	11,047	18,297
1875	166,638	958,169	1912	14,484	39,092
1876	128,049	736,282	1913	25,198	85,809
1877	107,789	619,787	1914	11,859	28,806
1878	134,237	771,863	1915	10,299	26,662
1879	147,879	850,304	1916	4,037	7,030
1880	236,950	1,362,463	1917	3,527	7,691
1881	140,000	805,000	1918	6,343	16,149
1882	112,592	647,404	1919	2,983	8,203
1883	76,162	380,810	1920	2,078	5,450
1884	77,485	309,950	1921	12,467	63,578
1885	71,615	286,460	1922	27,020	135,100
1886	100,000	300,000	1923	1,010	5,090
1887	50,000	150,000	1924	1,425	8,800
1888	95,000	380,000	1925	730	3,880
1889	121,280	288,232	1926	1,100	5,000
1890	110,711	283,019	1927	200	1,100
1891	93,301	204,902	1928	782	4,542
1892	85,178	209,711	1929	450	2,476
1893	72,603	167,555	1930	10,885	59,858
1894	59,887	139,862	1931	12,551	77,607
1895	79,858	193,790			
1896	70,649	161,335	Totals	5,233,278	$23,248,941
1897	87,449	196,255			

The tonnages in the above table for the years 1861–1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93–94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

NATURAL GAS

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV, Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary, Oil & Gas Supervisor, Dec., 1919; Aug., 1922; Mar., 1923; Mar. and Apr., 1926.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-

estimated, particularly in the six oil-producing counties. It must be remembered that some of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The most notable gas developments in California have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district; in the oil fields in the Los Angeles basin, Los Angeles and Orange counties; in Ventura County; and during 1928 the bringing in of the Kettleman Hills field in Kings County.

The use of natural gas will be furthered in the industry of the state; first, by the construction of pipe lines to all of the principal cities in the state, and, second, by a law passed by the last legislature making the unreasonable waste of natural gas illegal. Heretofore all gas that could not be sold or used on the property was wasted, but now it has to be used or the well is closed in until such a time when it can be used.

Pipe Lines and Distribution of Natural Gas.

During the past thirteen years more than 5000 miles of natural gas pipe lines have been laid in California. With the laying of the pipe lines the amount of natural gas used has increased as well as the uses to which it is put. At the present time, the value of this material is second only to petroleum. Natural gas is also being compressed into containers of various sizes and shipped in this form to places where it is not practical to build pipe lines.

The compressed gas in small containers makes it possible for people living in isolated places to have gas for cooking, heating, and lighting. There is a project now under way to compress the natural gas into specially built tank cars, ship it to Oregon and Washington and there distribute it to the gas mains of the various towns. This system will give service to California cities not accessible to pipe lines.

The year 1930 saw a continuation in the construction of natural gas pipe lines from the major oil fields to the larger centers of population, and the addition of new projects. There is a line from Kettleman Hills to Los Angeles to be built; also branch lines from that running up the San Joaquin to San Francisco and to all of the principal towns in the San Joaquin and lower Sacramento valleys not already serviced with natural gas.

In 1929 a law was passed prohibiting the unreasonable waste of natural gas, which has lessened the per cent of gas wasted and has encouraged the finding of new domestic and industrial uses for this material. The following table shows the total amount of natural gas coming from oil gas wells in California during 1931; that which was utilized for fuel, light and power; that which was wasted (blown into the air); and that which is pumped into old gas wells for storage.

Actual Production of Natural Gas—How Disposed of in California

County	M cu. ft. produced	M cu. ft. utilized	M cu. ft. wasted	M cu. ft. stored
Fresno	5,593,861	5,591,304	2,557	
Kern	35,154,806	26,577,942	4,496,014	4,080,850
Kings	159,640,330	120,253,916	38,989,134	397,280
Los Angeles	129,039,007	117,606,814	7,422,688	4,009,505
Orange	16,144,651	14,547,404	730,910	866,337
Santa Barbara	12,710,324	6,534,435	5,797,173	378,716
Ventura	65,347,553	53,643,509	11,039,797	664,247
Other counties	204,596	204,596		
Totals	423,835,128	344,959,920	68,478,273	10,396,935

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1931 gave from 2¢ to 36¢ per 1000 cu. ft. at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1931 works out at approximately 4.84¢ per M cu. ft. Approximately 7000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine, and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed' or Utilized for Fuel, 1931

County	M cu. ft.	Value
Fresno	5,591,304	$253,937
Kern	26,577,942	1,444,732
Kings	120,253,916	4,636,107
Los Angeles	117,606,814	6,489,448
Orange	14,547,404	1,494,853
Santa Barbara	6,534,435	446,885
Ventura	53,643,509	1,875,264
Butte, Humboldt, Lake, Mendocino, Sacramento, San Mateo, San Joaquin, Santa Clara*	204,596	49,467
Totals	344,959,920	$16,690,695

*Combined to conceal the output of a single operator in each.

The above totals were an increase in amount with a decreased value as compared with the 1930 output utilized, which was 315,413,952 M cu. ft. worth $24,559,840. As in the past, the Los Angeles County production had the largest value and was 117,606,814 M cu. ft. worth $6,489,448. It was passed by Kings County in quantity, which had 120,258,916 M cu. ft. worth $4,636,107. Fresno, Kings, and Santa Barbara counties showed increases in the amounts of gas utilized over that in 1930. The Los Angeles County output for 1930 was 156,470,411 M cu. ft. worth $14,065,968.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in

California was from the famous courthouse well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Natural Gas Production in California Since 1888

Year	M cubic feet	Value	Year	M cubic feet	Value
1888	[a]12,000	$10,000	1911	[a]5,000,000	$491,859
1889	[a]14,500	12,680	1912	[a]12,600,000	940,076
1890	[a]41,250	33,000	1913	14,210,836	1,053,292
1891	[a]39,000	30,000	1914	16,529,963	1,049,470
1892	[a]75,000	55,000	1915	21,992,892	1,706,480
1893	[a]84,000	68,500	1916	28,134,365	2,871,751
1894	[a b]85,080	79,072	1917	44,343,020	2,964,922
1895	[a b]110,800	112,000	1918	46,373,052	3,289,524
1896	[a b]131,100	111,457	1919	52,173,503	4,041,217
1897	[a]71,300	62,657	1920	58,567,772	3,898,286
1898	[a]111,165	74,424	1921	67,043,797	4,704,678
1899	115,110	95,000	1922	103,628,027	6,990,030
1900	40,566	34,578	1923	240,405,397	15,661,433
1901	120,800	92,034	1924	209,021,596	15,153,140
1902	120,968	99,443	1925	194,719,924	15,890 082
1903	120,134	75,237	1926	214,549,477	19,465,347
1904	144,437	91,035	1927	224,686,940	20,447,294
1905	148,345	102,479	1928	260,887,116	22,260,947
1906	168,175	109,489	1929	400,129,201	29,675,546
1907	169,991	114,759	1930	315,513,952	24,559,840
1908	842,883	474,584	1931	344,959,920	16,690,695
1909	1,148,467	616,932			
1910	10,579,933	1,676,367	Totals	2,890,865,754	$218,036,656

[a] Quantity, in part, estimated, where values only were reported.
[b] Includes natural CO_2 from a mine in Santa Clara County.

Gasoline from Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 135 plants were in operation in 1931 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the old fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the gas pipe lines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipe lines thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained.

A total of 676,940,479 gallons of casing-head gasoline valued at $31,254,688 was reported made from all fields in California by 135 plants during 1931, compared with 842,958,320 gallons worth $56,870,002 from 140 plants in 1930. It was distributed as follows:

County	No. plants	Gallons	Value
Kern	24	45,243,106	$2,481,552
Kings	6	169,930,979	9,488,231
Los Angeles	69	321,127,052	13,321,364
Orange	19	50,652,412	2,178,078
Santa Barbara	5	25,332,680	1,224,407
Ventura	11	64,186,337	2,543,931
Others	1	467,913	17,125
Totals	135	676,940,479	$31,254,688

The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. The U. S. Bureau of Mines Reports by Knudsen[1] gives the average recovery for 1931 as 1.470 gallons per 1000 cu. ft. of gas treated. His figures show the following production, by methods:

Natural-Gas Gasoline Production, 1930, by Methods

Per U. S. Bureau of Mines

	M cu. ft. natural gas treated	Gallons gasoline recovered	Recovery, gal. per M cu. ft.
Oil absorption	455,429,557	670,026,736	1.471
Compressor	2,037,496	2,386,164	1.171
Totals	457,467,053	672,412,900	1.470

PETROLEUM

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919, to June, 1929, and quarterly from then on). U. S. Geol. Surv. Bulletins 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691. Prof. Papers 116, 117. "American Petroleum; Supply and Demand"; Amer. Petr. Inst., 1925.

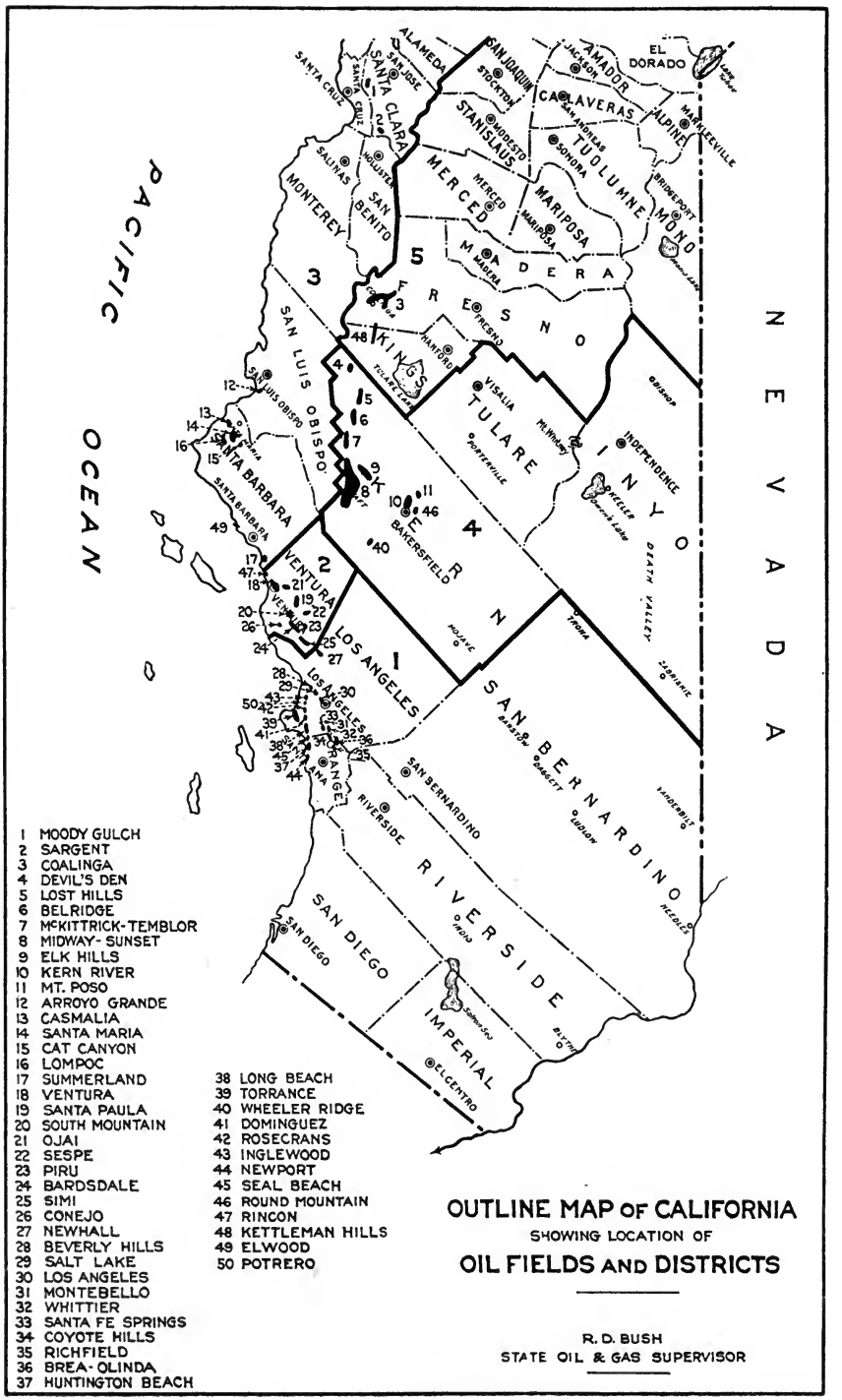
The crude petroleum produced in California during 1931 amounted to a total of 188,310,605 barrels, having a value of $141,835,723 at the well; this was a large decrease in both quantity and value from the 1930 output, which was 227,328,988 barrels worth $271,699,046.

This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the old Los Angeles City Field not under the jurisdiction of the Supervisor until August 14,1931.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such.

The value used in the statistical reports of the State Mining Bureau and the Division of Mines and Mining from 1914 to 1927 (inc.) was derived from an average of actual sales of crude oil of all grades in each

[1] Knudsen, E. T., The Petroleum situation in the Pacific Coast territory (Monthly for 1931), U. S. Bureau of Mines.



OUTLINE MAP OF CALIFORNIA
SHOWING LOCATION OF
OIL FIELDS AND DISTRICTS

R. D. BUSH
STATE OIL & GAS SUPERVISOR

field of the state and their average applied to the total yield of each respective field. The 1929–1931 values, used by the Division of Mines, were obtained by using the production of crude oil by gravities produced in each field [1] and applying an average of current prices quoted in Oil Bulletin for crude oil at the well.

TABLE A

Production and Value of Crude Oil by Counties

County	1930		1931	
	Barrels	Value	Barrels	Value
Fresno	3,362,902	$1,910,128	2,991,976	$1,649,476
Kern	44,170,810	37,015,139	35,794,138	22,765,072
Kings	6,176,130	9,437,771	17,607,527	12,735,524
Los Angeles	114,533,366	148,549,776	85,382,013	66,999,266
Orange	23,113,820	24,500,649	17,564,062	13,231,012
Santa Barbara	15,914,132	22,343,440	11,660,456	11,121,743
Ventura	19,983,341	27,896,744	17,245,113	13,297,707
Colusa San Luis Obispo, Santa Clara, Tulare	74,487	45,399	------	------
San Luis Obispo, Santa Clara, Tulare	------	------	65,315	35,923
Totals	227,328,988	$271,699,046	188,310,605	$141,835,723

The foregoing totals show the average price of $0.753 per barrel for the year in 1931, as compared with $1.195 in the year 1930, $1.094 in 1929, $0.992 in 1928, $1.127 in 1927.

TABLE B

Average Price of Oil Per Barrel, by Counties, 1922-1931

County	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931
Fresno	$1.068	$1.710	$1.162	$1.094	$0.815	$0.830	$0.764	$0.519	$0.568	$0.551
Kern	1.211	.819	1.137	1.432	1.448	1.139	.835	.741	.838	.636
Kings								1.674	1.515	.723
Los Angeles	1.403	.971	1.239	1.429	1.645	1.115	1.051	1.189	1.297	.784
Orange	1.175	.880	1.183	1.417	1.559	1.207	.935	.986	1.060	.753
San Luis Obispo	.942	.600	.992	1.087						
Santa Barbara	1.011	.782	1.036	.914	.793	.750	1.108	1.255	1.404	.954
Santa Clara	1.616	1.404	1.921	1.634						
Ventura	1.785	1.138	1.334	1.710	1.512	1.177	1.098	1.150	1.396	.771
State averages	$1.249	$0.923	$1.200	$1.422	$1.538	$1.127	$0.992	$1.094	$1.195	$0.753

For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil in the San Joaquin Valley fields. In 1919 and since, the average values have worked out at figures corresponding to quotations up to, in one year as high as 28° oil, due to the large yield of high-gravity oils from the new fields in the Los Angeles-Orange counties area.

Features of 1931.

The noteworthy feature of the year 1931 in the oil industry in California was the variations in the price of crude oil at the well. On March 20th there was a cut of 5¢ a barrel on all crudes less than 18° B. gravity in the Los Angeles Basin fields and as much as $1.38 a barrel on gravity of 42° B.; while in the San Joaquin Valley fields there were no price

[1] By courtesy of Standard Oil Co.

changes in oils heavier than 18° B., but as much as $1.07 a barrel on 35° B. material. This price reduction was followed by another on March 31st, which affected all crude oils lighter than 18° B. and brought the prices as low as 35¢ a barrel on material weighing 29° B. in the San Joaquin Valley fields and 30° B. in the Los Angeles Basin fields. This was the first time in the history of California oil fields that the prices of the heavier grades were more than those of the lighter. This condition lasted until June 19th, when there was a small increase in the prices of the lighter oils to bring them slightly more than that of the heavier.

Summarizing the data for the year, the State Oil and Gas Supervisor [1] presents the following:

Production.

"The total production in the State for the last six months of 1931 was 92,942,495 barrels of oil and 50,149,595 barrels of water. The production of oil for the year 1931 was, therefore, 188,270,605 barrels, a decrease of 38,884,577 barrels compared with that of 1930.

The production of oil for the second half of 1931 was 2,385,615 barrels less than for the first half. Water production increased 1,395,575 barrels during the same period. * * *

"The estimated closed-in production was increased during 1931 from 263,272 barrels daily in January to a maximum of 296,887 barrels in December.

Storage and Price Changes.

"The total crude and refined petroleum in storage in Pacific Coast territory at the end of 1931 was 169,836,949 barrels, according to the American Petroleum Institute. The decrease in storage during the year was 10,360,444 barrels compared with a decrease of 4,620,926* barrels during 1930. The total amount of crude and refined oil shipped to eastern ports during 1931 was 17,836,000 barrels, or 7,807,000 barrels less than 1930 shipments. In March, 1931, prices of crude oil which ranged from 55 cents to $2.08 per barrel in various fields were reduced twice to prices ranging from 55 to 70 cents per barrel. Again at the end of March prices of the higher gravity oils were reduced, and ranged downward from 55 cents for the heavy gravity oil to 35 cents for the higher gravities, the reverse of usual values. In June, 1931, prices of the higher gravities were increased and ranged from 55 cents per barrel for heavy gravity oil to 87 cents per barrel for the higher gravities.

Drilling and Development.

"During 1931, 329 wells are reported to the State Oil and Gas Supervisor as ready to drill as compared with 918 new wells in 1930. New potential production was added to the State's resources in the discovery of a new productive area on the Ventura anticline called San Miguelito, discovery of oil in the Sespe sands in Elwood field, discovery of oil in an unproved area in Cat Canyon field, and from the Temblor sands in the Kettleman Middle Dome field."

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt counties. In the light of present-day developments, the following reference to the previous year's production of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

"It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate the wheels of commerce and set a trade at work excelling in variety any that has

[1] Bush, R. D., Resume of Oil Fields Operations in 1931, Summary of Operations—California Oil Fields, Vol. 17, No. 3, Jan., Feb., March, 1931.

*Revised figure.

thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[1] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

"Work was commenced in Pico Canyon in 1875 by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."[2]

In 1877 Pico averaged 40–50 bbl. daily, and Ventura 80 bbl. daily. In 1878, there was some production (at 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County; in 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County; but the production from the large number of new wells started in these new Los Angeles County fields did not reach its peak until August and September, 1923. Dominguez (Compton) came in during 1923; followed by Rosecrans and Inglewood in 1924. Ventura recorded important additions to its producing area in 1925 and 1926. Seal Beach, Orange County, and Mt. Poso, Kern County, were the new fields added in 1926; Round Mountain, Kern County, and Rincon, Ventura County, were the new fields added in 1927; with Potrero in Los Angeles County, Elwood in Santa Barbara County and Kettleman Hills in Kings County in 1928.

During 1929 Playa Del Rey was added to the oil fields in Los Angeles County.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

[1] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.
[2] *Idem*, p. 301.

TABLE C

Total Petroleum Production in California

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	[a] 175,000	[b] $472,500	1904	29,736,003	$8,317,809
1876	12,000	30,000	1905	34,275,701	9,007,820
1877	13,000	29,250	1906	32,624,000	9,238,020
1878	15,227	30,454	1907	40 311,171	16,783,943
1879	19,858	39,716	1908	48,306,910	26,566,181
1880	40,552	60,828	1909	58,191,723	32,398,187
1881	99,862	124,828	1910	77,697,568	37,689,542
1882	128,636	257,272	1911	84,648,157	40,552,088
1883	142,857	285,714	1912	89,689,250	41,868,344
1884	262,000	655,000	1913	98,494,532	48,578,014
1885	325,000	750,750	1914	102,881,907	47,487,109
1886	[a] 377,145	[b] 870,205	1915	91,146,620	43,503,837
1887	678,572	1,357,144	1916	90,262,557	57,421,334
1888	690,333	1,380,666	1917	95,396,309	86,976,209
1889	303,220	368,048	1918	99,731,177	127,459,221
1890	307,360	384,200	1919	101,182,962	142,610,563
1891	323,600	401,264	1920	103,377,361	178,394,937
1892	385,049	561,333	1921	112,599,860	203,138,225
1893	470,179	608,092	1922	138,468,222	173,381,265
1894	783,078	1,064,521	1923	262,875,690	242,731,309
1895	1,245,339	1,000,235	1924	228,933,471	274,652,874
1896	1,257,780	1,180,793	1925	232,492,147	330,609,829
1897	1,911,569	1,918,269	1926	224,673,281	345,546,677
1898	2,249,088	2,376,420	1927	231,195,774	260,735,498
1899	2,677,875	2,660,793	1928	231,811,465	229,998,680
1900	4,319,950	4,152,928	1929	292,534,221	321,366,863
1901	7,710,315	2,961,102	1930	227,328,988	271,699,046
1902	14,356,910	4,692,189	1931	188,310,605	141,835,723
1903	24,340,839	7,313,271			
			Totals	3,714,799,825	$3,788,536,932

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.
[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

Well Data.

The following table is compiled from the monthly statements issued by the American Petroleum Institute:

TABLE D

Wells Operated, by Fields, 1931

Field	Wells producing Dec. 1930	Wells producing Dec. 1931	Wells completed during year	Daily initial output	Wells abandoned during year	Bbls. per well produced per day Dec. 1930	Bbls. per well produced per day Dec. 1931
GROUP No. 1—Coalinga	739	621			2	12.5	11.9
Elk Hills	212	205			7	84.9	62.0
Fruitvale	18	20	3	1,205	1	137.5	161.1
Kern River	887	906	6	965	4	16.5	10.7
Kettleman Hills	8	24	23	234,000	0	2,126.5	2,487.9
Lost Hills-Belridge	164	159	5	11,953	13	21.9	58.0
McKittrick	239	121			12	17.1	14.7
Midway-Sunset	1,868	1,711	7	1,160	21	34.4	29.2
Mount Poso	66	73	7	1,250	3	161.2	114.9
Round Mountain	4	7	2	555	4	818.5	215.9
Wheeler Ridge	34	33			2	17.7	15.8
GROUP No. 2—Capitan	5		2	310	4	13.8	
Elwood	52	49	6	14,091	2	769.5	400.7
Rincon	33	33	3	1,352	1	83.3	48.6
San Miguelito		2	1	635	0		255.5
Santa Barbara	2	5	4	888	2	17.5	35.8
Santa Maria	184	166	2	1,250	9	17.2	15.3
Summerland	97	62			2	3.3	2.0
Ventura Avenue	145	138	25	32,268	1	330.5	294.6
Ventura-Newhall	414	410	5	965	34	11.7	9.4
Watsonville	6	6			0	10.3	10.2
GROUP No. 3—Coyote	183	159	6	1,130	18	58.2	63.7
Dominguez	62	50	7	7,644	2	157.0	257.6
Fullerton	367	356	1	50	3	33.0	26.6
Huntington Beach	404	324	2	490	7	75.3	68.8
Inglewood	211	210	4	998	1	83.8	65.3
Lawndale	8	7			1	44.8	43.4
Long Beach	905	884	37	14,062	42	110.8	86.3
Los Angeles-Salt Lake	259	259			0	5.8	4.3
Montebello	164	167			4	45.8	38.8
Newport	4	1	2	155	1	10.0	16.0
Playa Del Rey	141	174	66	32,520	16	91.7	122.9
Potrero	17	10	5	2,336	8	102.9	110.1
Richfield	175	148			10	57.0	44.6
Rosecrans	100	63	1	50	15	66.7	50.1
Santa Fe Springs	464	421	5	1,657	16	258.5	151.0
Seal Beach	127	108	2	115	6	173.2	121.8
Torrance	526	346	4	380	16	21.4	17.5
Whittier	160	171			1	8.9	6.1
GROUP No. 4—Buttonwillow Gas Field		1	1		1		
Dudley Ridge Gas Field			2				
Goleta Gas Field		2			3		
Miscellaneous drilling					120		
Totals	9,454	8,612	246	364,434	415	*66.1	*58.3

*State average.

Specific Gravity of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E, following, for which we are indebted to the Standard Oil Company. Under present practice, oil below 18° Baumé may be considered as largely refinable for fuel and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County and 60° in Kettleman Hills, Kings County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County fields; Western Minerals area, south of Maricopa; Wheeler Ridge, Kern County.

TABLE E

Production of Light and Heavy Oils, by Fields, for 1931

Field	Under 20° (barrels)*	20° above (barrels)*	Total (barrels)*
Kern River	3,900,419		3,900,419
Round Mountain	245,056		245,056
Mount Poso	3,008,913		3,008,913
Fruitvale	275,247	591,189	866,436
Lost Hills-Belridge	118,998	2,894,393	3,013,391
McKittrick	891,526	3,434	894,960
Elk Hills	1,756,840	3,168,601	4,925,441
Midway-Sunset	5,979,240	12,776,556	18,755,796
Wheeler Ridge		192,899	192,899
Coalinga	2,907,571	85,772	2,993,343
Kettleman Hills		17,503,369	17,503,369
Miscellaneous	1,804		1,804
Watsonville	23,725		23,725
Arroyo Grande	39,859		39,859
Santa Maria	201,388	766,156	967,544
Summerland	58,370		58,370
Ventura Avenue		15,243,693	15,243,693
Ventura County	21,774	1,191,748	1,213,522
Newhall		130,608	130,608
Elwood		10,470,339	10,470,339
Santa Barbara Mesa	109,112		109,112
Capitan		53,183	53,183
Rincon		717,097	717,097
Salt Lake	325,390		325,390
Los Angeles	146,689		146,689
Montebello	227,164	2,205,330	2,432,494
Whittier	30,229	143,618	473,847
Coyote	36,081	3,710,973	3,747,054
Fullerton	237,677	3,386,106	3,623,783
Richfield	460,022	1,975,206	2,435,228
Santa Fe Springs		24,299,507	24,299,507
Huntington Beach	1,138,331	6,689,502	7,827,833
Torrance	1,383,947	816,138	2,200,085
Dominguez	114,286	4,061,388	4,175,674
Rosecrans	8,248	1,325,460	1,333,708
Inglewood	1,647,800	3,641,927	5,289,727
Seal Beach		4,891,606	4,891,606
Potrero		354,158	354,158
Playa Del Rey	60,904	9,749,286	9,810,290
Long Beach	452,686	29,746,830	30,199,516
Miscellaneous	9,789		9,789
Lawndale		122,300	122,300
Totals	26,119,085	162,908,472	189,027,557

*Barrels of 42 gallons.

As previously noted by Bradley,[1] a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1920, taking 18° Baumé as the dividing line. This subject has also been covered in detail and with charts, by Collom and Barnes.[2]

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low—25% high in 1914 to 25% low—75% high in 1921; 10% low—90% high in 1923; 14% low—86% high in 1924–1931.

This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as well as its effect upon the relative situation between production and consumption. It has been a fortunate development, in view of the increased demand for refinery products (gasoline in particular).

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refined products in the Pacific Coast territory totaled 169,835,949 barrels[3] December 31, 1931, as compared with 180,196,393 barrels on December 31, 1930. The total increase in stock for the year was 10,360,484 barrels.

	December 31, 1931 (barrels)	*December 31, 1930 (barrels) revised*
Heavy crude and all grades of fuel	99,301,196	106,501,454
Refinable crude	41,895,200	43,298,161
Finished gasoline, engine distillate and natural gasoline	15,820,753	17,711,334
Crude gasoline and naptha distillates	4,105,131	2,887,581
All other stocks	8,713,669*	9,797,863
Total all stocks	169,835,949	180,196,393

* Includes 630,113 bbls. coke.

Utilization of California's Crude Oil.

Most of the crude oil produced in California is sent to storage reservoirs at the tank farms near the oilfields and from these reservoirs by pipe line to the refineries, the larger ones of which are located in the vicinity of Los Angeles or on San Francisco Bay.

During 1931 the crude oil consumed in California, according to the U. S. Bureau of Mines[4] was 174,396,301 barrels sent to the stills at the refineries and 7,523,885 barrels to foreign shipments. In addition there were 10,878,193 barrels of natural gasoline, either sent to the stills or blended with the finished product in the state.

The production of petroleum products during 1931 refined in California are shown in Table F.

[1] Bradley, W. W., Mineral Production of California in 1921; Cal. State Min. Bur., Report XVIII, p. 442, Sept., 1922.
[2] Collom, R. E., and Barnes, R. M., California Oil Production and Reserves; Cal. State Min. Bur., Ninth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1923, pp. 5–23.
[3] Standard Oil Bulletin, February, 1932, p. 14.
[4] Knudsen, E. T., The petroleum situation in the Pacific Coast territory (monthly) 1931, U. S. Bureau of Mines.

TABLE F

Commodity	*Amount*
Gasoline and engine distillate	69,942,078 barrels
Kerosene	4,437,663 barrels
Lubricating oils and greases	1,860,233 barrels
Gas oil and Diesel oil	21,409,162 barrels
Fuel oil, residium and heavy crude	76,033,137 barrels
Asphalt	442,549 tons
Road oil	1,043,353 barrels
Coke	12,439 tons
Other finished products	1,884,581 barrels
Unfinished, tops	1,688,722 barrels
Other oils	1,523,514 barrels
Shortage	4,400,122 barrels

Operating Data.

The following tabulation (Table G) is compiled from data published by the Department of Petroleum and Gas,[1] semiannually, and here combined to show the entire year's operations for all fields. The districts are the geographical subdivisions as administered by the Department, and which are outlined on the accompanying map.

It will be noted that the state average yield of oil per well per day was 73.7 barrels for the first six months of 1930 and 68.4 barrels for the second. This is somewhat higher than the figure of 66.1 barrels average for December derived from American Petroleum Institute data as shown in Table D, on a previous page, due in part at least, to the fact that the latter is on a full-time basis, whereas the Bureau figures allow for shut-down time.

[1] Summary of Operations, California Oil Fields; Division of Oil and Gas, Fifteenth Annual Report of State Oil and Gas Supervisor, Vol. 17, No. 1, July, Aug., Sept., 1930, and No. 3, Jan., Feb., March, 1931.

TABLE G. Production Statistics and Operating Data of California Oil Fields—1931

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
Dist. 1—Beverly Hills	13	67,890	2,142	31.7	22.2	91.0	13	67,016	2,193	30.6	22.4	91.7
Brea-Olinda	367	1,857,563	61,262	30.3	14.5	92.2	380	1,804,385	64,933	27.8	13.2	92.9
Coyote Hills	176	1,824,643	23,902	61.0	45.7	93.9	161	1,894,942	26,048	72.7	42.5	87.9
Dominguez	55	2,070,482	9,566	216.4	96.4	96.1	60	2,120,427	9,625	220.3	90.7	87.2
*Huntington Beach	401	3,933,550	60,792	64.7	56.2	83.8	355	3,821,907	54,013	70.8	51.4	82.7
Inglewood	215	2,789,494	36,086	77.3	44.9	92.7	213	2,532,765	35,670	71.0	48.4	91.0
Lawndale	5	55,302	789	70.1	19.1	87.2	7	66,481	1,048	63.4	20.9	81.4
*Long Beach	905	16,012,486	148,565	107.8	65.7	90.7	920	14,212,758	154,578	91.9	67.7	91.3
Los Angeles City							162	36,083	27,205	1.3	0.7	91.3
Montebello	186	1,259,583	31,323	40.2	82.8	93.0	181	1,174,424	31,017	37.9	84.5	93.1
Newhall	58	80,102	10,153	7.9	2.4	96.7	56	58,379	10,174	5.7	2.7	98.7
Newport	2	906	300	3.0	0.2	82.9						
*Playa Del Rey	165	5,356,501	26,731	200.4	24.9	89.5	182	3,854,337	29,765	129.5	30.8	88.9
*Potrero	10	141,808	1,530	92.7	47.3	84.5	10	188,453	1,613	116.8	63.3	87.7
*Richfield	184	1,222,726	23,435	52.2	13 6	70.4	170	1,203,445	22,799	52.8	13.8	72.9
Rosecrans	84	724,121	13,214	54.8	50.0	86.9	69	616,321	10,990	56.1	53.7	86.6
Salt Lake	39	115,616	6,650	17.4	31.3	94.2	23	72,388	4,014	18.0	50.4	94.8
*Santa Fe Springs	462	12,747,324	73,663	173.0	68.9	88.1	444	11,438,192	71,401	160.2	78.5	87.4
Seal Beach	110	2,607,826	17,817	146.4	130.6	89.5	96	2,217,079	15,127	146.6	163.5	85.6
Torrance	384	1,103,011	57,948	19.0	3.7	83.4	377	1,079,039	60,217	17.9	3.5	86.8
Whittier	171	243,265	28,762	8.5	30.0	92.9	170	233,060	29,348	7.9	26.9	93.8
Totals	3,992	54,214,199	640,630	84.6	48.5	88.7	4,049	48,691,881	661,778	73.6	48.0	88.8
Dist. 2.—Barsdale	104	97,183	16,618	5.8	1.5	88.3	73	82,841	11,643	7.1	1.5	86.7
Conejo	26	450	728	0.6	2.7	15.5	26	683	542	1.3	6.3	11.3
Ojai	23	13,546	4,020	3.4	0.1	96.6	28	12,058	4,154	2.9	0.03	80.6
Piru	91	71,010	13,291	5.3	3.7	80.7	94	59,321	8,864	6.7	3.8	51.2
Rincon	36	379,073	5,688	66.6	25.8	87.3	35	355,720	5,698	62.4	21.8	88.5
Santa Paula	20	9,037	2,308	3.9	1.1	63.8	35	10,190	2,898	3.5	1.3	45.0
Sespe	27	21,947	2,822	7.8	0.6	57.7	38	33,874	2,913	11.6	0.5	41.7
Simi	43	5,674	2,912	7.5	0.8	59.6	45	14,567	4,935	3.0	1.2	59.6
South Mountain	69	415,120	10,803	38.4	0.6	86.5	71	351,893	10,287	34.2	0.9	78.7
Ventura	147	7,950,299	24,328	326.8	40.3	91.4	151	7,360,627	25,295	291.0	41.0	91.0
Totals	586	8,963,339	82,304	108.9	14.8	77.6	596	8,281,774	77,229	107.2	16.0	70.4

TABLE G. Production Statistics and Operating Data of California Oil Fields—1931—Continued

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbls.)	Number of days producing	Production per well per day (bbls.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
DIST. 3.—Arroyo Grande	16	20,174	2,464	8.2	12.4	85.1	17	30,026	2,683	11.2	13.1	85.8
Capitan	3	53,183	378	140.7	3.7	69.6	0	0	0	0	0	0
Casmalia	11	36,309	1,627	22.3	80.8	81.7	11	33,153	1,229	27.0	99.9	60.7
Cat Canyon	11	79,146	1,941	40.8	32.9	97.5	11	78,773	1,843	42.7	33.6	91.1
Elwood	46	5,991,769	7,090	845.1	53.8	85.2	50	4,477,541	8,369	535.0	69.8	91.0
Lompoc	1	3,594	12	299.5	21.3	6.6	1	3,830	14	273.6	20.7	7.6
Mesa	3	53,576	452	118.5	5.3	83.2	4	34,891	339	102.9	22.7	46.1
Santa Maria	125	380,599	15,918	23.9	43.0	70.4	124	379,249	15,372	24.7	46.0	67.4
Sargent	8	4,301	1,446	3.0	0.1	99.9	9	4,450	1,280	3.5	0.1	77.3
Summerland	61	28,986	2,929	9.9	16.5	26.5	62	25,857	11,040	2.3	3.9	96.8
San Luis Obispo County:												
Huasna District	1	1,565	90	17.4	34.6	50.0	1	1,584	184	8.6	25.0	100.0
Santa Barbara County:												
More District	0	0	0	0	0	0	0	0	0	0	0	0
Totals	286	6,653,202	34,347	193.7	39.2	66.4	290	5,069,354	42,353	119.7	37.0	79.4
DIST. 4.—Belridge	114	1,168,193	18,327	63.7	7.4	88.8	77	1,553,318	13,559	114.6	8.1	95.7
Devils Den	1	764	10	76.4	27.0	----------	1	2,569	33	77.8	29.0	----------
Elk Hills	215	2,628,742	36,266	72.5	59.4	93.2	209	2,290,667	35,678	64.2	64.4	92.8
Fruitvale	18	403,143	3,040	132.6	5.4	93.3	20	469,378	3,333	140.8	7.2	90.6
Kern River	909	1,986,482	151,689	13.1	10.4	92.2	980	1,904,516	164,626	11 6	11.6	91.3
Lost Hills	52	88,979	7,730	11.5	22.2	82.1	80	166,701	13,531	12.3	16.4	91.9
McKittrick-Temblor	204	534,673	35,054	15.3	61.8	94.9	128	328,747	23,088	14.2	82.3	98.0
Midway-Sunset	1,814	9,597,561	300,606	31.9	22.8	91.6	1,782	9.207,456	296,151	31.1	22.4	90.3
Mount Poso	72	1,410,107	9,050	155.8	44.6	69.4	80	1,607,224	10,846	148.2	79.1	73.7
Round Mountain	2	22,847	100	228.5	312.4	----------	6	220,579	783	281.7	139.7	70.9
Wheeler Ridge	34	96,904	6,000	16.2	2.6	97.5	33	95,993	5,681	16.9	2.7	93.6
Kern County	1	4,463	100	44.6	7.7	----------	3	4,132	71	58.2	4.8	----------
Tulare County	1	1,700	76	22.4	121.7	----------	2	1,515	146	10.4	360.8	----------
Totals	3,437	17,944,558	568,048	31.6	23.8	91.3	3,401	17,852,795	567,526	31.5	24.9	90.7

DIST. 5.—Coalinga	715	1,565,211	123,777	12.6	12.3	95.6	655	1,426,765	113,361	12.6	12.3	94.1
Kettleman Hills	11	5,987,601	1,719	3,483.2	44.6	86.3	24	11,619,926	3,904	2,976.4	21.3	88.4
Totals	726	7,552,812	125,496	60.2	12.8	95.5	679	13,046,691	117,265	111.3	12.6	93.9
Grand totals	9,027	95,328,110	1,450,825	65.7	33.6	88.8	9,015	92,942,495	1,466,151	63.4	34.2	88.4
*The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:												
DIST. 1.—Huntington Beach	3	15,020	485				3	22,218	552			
Lawndale							1	9,920	184			
Long Beach	11	130,724	1,900				13	171,820	2,257			
Playa del Rey	24	451,431	4,186				14	143,174	2,577			
Potrero	1	14,000	142									
Richfield	1	1,200	90									
Santa Fe Springs	2	39,500	366									
Torrance							2	3,120	240			

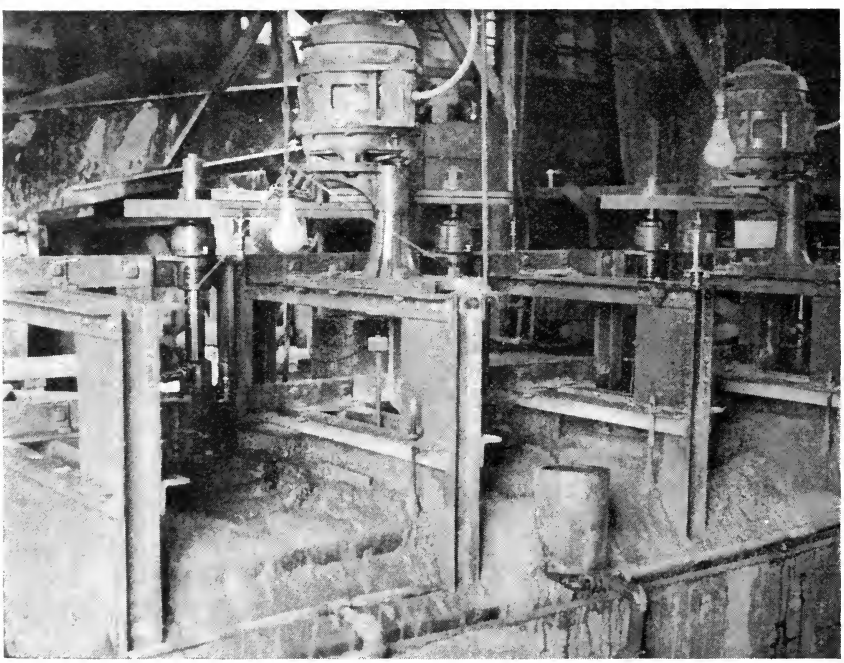
[1] Three wells producing part time.
[2] Two wells producing part time.

CHAPTER THREE

METALS

Bibliography: Reports of State Mineralogist I–XXVIII (inc.). Bulletins 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95. Spurr and Wormser, "Marketing of Metals and Minerals." See also under each metal.

The total value of metals produced in California during 1931 was $13,535,494. Chief among these is and always has been gold; followed



Kraut 4-cell flotation unit at Empress Mine, near Grass Valley, Nevada County.

Photo by Walter W. Bradley

by copper, quicksilver, silver, lead, platinum, tungsten, zinc, manganese and iron ore.

There was no production of antimony, arsenic, cadmium, molybdenum, nor titanium, which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the State, although there has yet been no commercial output of them. The above-noted total of this group is a net decrease of $1,512,735 from the 1930 total of $15,048,229. Copper showed the largest decline in production.

California leads all states in the Union in her gold production and is credited with approximately 22% of the nation's yield in 1931. The precious metal is widely distributed through the state. Thirty-

eight of the fifty-eight counties reported an output in 1931 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties, and the southern belt in San Bernardino, Riverside and San Diego counties.

Silver is not generally found alone in the state, except notably in the Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead and zinc.

Quicksilver has for many years been one of the state's staple products and California in 1931 supplied approximately 55% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.

Titanium is associated with some of California's iron deposits. This mineral is widely distributed through the United States, but the deposits of this state are among the few that are considered of commercial importance.

Although the United States is a large consumer of certain metals, in fact the largest particularly of chromium and tin, our production from domestic sources is deficient. We have large reserves of low-grade chromite, manganese, tungsten and antimony ores, but they do not fully supply our commercial needs.

A comparison of the 1931 output with that of the 1930 is afforded by the following table:

Substance	1930		1931		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Copper	26,534,752 lbs.	$3,449,522	12,954,842 lbs.	$1,178,890	$2,270,632—
Gold		9,451,162		10,814,162	1,363,000+
Lead	3,524,796 lbs.	176,241	3,934,240 lbs.	145,568	30,673—
Platinum	217 oz.	11,700	350 oz.	11,979	279+
Quicksilver	11,374 flasks	1,255,257	13,478 flasks	1,121,624	133,633—
Silver	1,622,803 fine oz.	624,779	867,818 fine oz.	251,667	373,112—
Zinc			149,865 lbs.	5,314	5,314+
Unapportioned*		79,568		6,290	73,278—
Total value		$15,048,229		$13,535,494	
Net decrease					$1,512,735

* Includes iron ore, manganese ore and tungsten.

ALUMINUM

Bibliography: Report XVIII, p. 198. Bulletins 38, 67. U. S. Geol. Surv., Min. Res. of U. S.

To date there has been no commercial production of aluminum ore in California. Only a single authenticated occurrence of bauxite has

thus far been noted in this state, being in Riverside County, southeast of Corona, but as yet undeveloped.

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence commercially, in the production of the metal: bauxite (to which may be added the related hydrated oxides, hydrargillite and diaspore) and cryolite. Cryolite is found in commercial quantities only in south Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been for some years the most important source of aluminum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0–10%. Besides its reduction to the metal bauxite is also utilized in the manufacture of aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive, and in the refining of oil. The most important producing countries, both of bauxite and the metal, are the United States and France. The United States leads with 36% of world's output of the metal, although France produces more bauxite than any other country. In 1913 France led.

ANTIMONY

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII, XXII, XXIII, XXV–XXVII (inc.). Bulletins 38, 91.

During 1931 there were no shipments of antimony ore in California although there was a small amount mined in Kern County. The last commercial production was made in 1928 when 20 tons of ore, calculated at 45% antimony, valued at $761 and coming from properties in Kern and San Bernardino counties, was shipped to a plant in Los Angeles for smelting.

Production of antimony in California has been irregular, and small in amount except during 1915–17 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony in California has come from Kern, Inyo and San Benito counties, and other occurrences have been noted in Nevada, Riverside, San Bernardino and Santa Clara counties. The commonest occurrence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

California producers claim they can not operate profitably unless the price of antimony be above 12 cents per pound. During most of 1925 and 1926 the price was up, at times as high as 23¢, and as a consequence there was some revival of antimony mining in California. Present New York quotations (July 31, 1931) are around 5¼¢ per pound for Chinese (duty paid) brands. China is the principal world source of antimony.

The antimony market (New York being the chief center) is recognized as one of the most unstable of the metal markets. As the world's requirements for antimony are comparatively small, the prices react sharply if an extra quantity of the metal be thrown onto the market, and the trade becomes so cautious that the market may disappear altogether, causing production to fall off rapidly.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper). An alloy of 6% antimony and 94% lead is being extensively used in making battery plates for storage batteries for automobiles, airplanes and radio apparatus.

Antimony Production in California, by Years.

The production of antimony ore in California by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1902		
1888	100	20,000	1915	510	$35,666
1889			1916	1,015	64,793
1893	50	2,250	1917	158	18,786
1894	150	6,000	1918		
1895	33	1,485	1925	*26	770
1896	17	2,320	1926		
1897	20	3,500	1927	20	590
1898	40	1,200	1928	20	761
1899	75	13,500	1929		
1900	70	5,700			
1901	50	8,350	Totals	2,429	$201,171

* Annual details concealed under 'Unapportioned.'

ARSENIC

Bibliography: Reports XVIII, XXIII, XXV. Bulletin 67, U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing; and in scorodite ($FeAso_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic,' for which there is a demand for the preparation of insecticides, for use in agriculture and horticulture, and especially against the cotton-boll weevil in the southern states.

Except for a small output in 1924, there has been no commercial recovery of arsenic from Californian ores. There having been only a single operator, the figures are concealed under the 'Unapportioned' item.

BERYLLIUM

Bibliography: State Mineralogist Report XXVII. Eng. & Min. Jour.-Press, Vol. 118, No. 8, p. 285, Aug. 23, 1924. U. S. Bureau of Mines Information Circular 6190.

Beryllium is a metal resembling aluminum closely in its chemical character. It has a specific gravity of 1.85, is almost as hard as quartz (will scratch glass) and will take a high polish. The use of beryllium as a metal is still more or less in the experimental stage because the cost of extracting the metal from its ores almost makes it prohibitive and the present sources of supply of the ore are limited. Not until such a time when deposits can be found that will assure a definite supply and metallurgical costs are such as to justify its use, will the metal be found in common use.

There has been some talk about the use of beryllium as a metal in airplane construction, although little has been done so far. Several alloys of beryllium have been made and tested successfully. The addition of 2% to 3% of the metal to copper and nickel makes a bronze that has the strength and hardness of carbon steel and resists corrosion. Copper with 1.3% beryllium is an alloy with a gold color and sonorous. When small percentages of beryllium are alloyed with aluminum, copper, iron or nickel, it increases their hardness and strength. Beryllium has been utilized in X-ray apparatus and for electrodes in neon signs.

Compounds of beryllium at present used commercially are the nitrate and the oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton, and the oxide has been added to materials being used for the manufacture of abrasive compounds and in dental cements. Beryllium sulphate has been used to some extent in medical research. Experiments of the use of the oxide in various glasses show that it gives a harder and more refractory glass than calcium or magnesium.

There are a number of beryllium minerals, but none have been found in commercial quantities, except beryl, which is a beryllium-aluminum silicate. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside counties; and an occurrence has recently been noted in western Inyo County, but the quantity is as yet unproved. Thus far there have been no commercial shipments of beryl from California except for gem purposes (the pink and aquamarine varieties).

BISMUTH

Bibliography: Bulletins 38, 67, 91. Am. Jour. Sci., 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, San Bernardino, and Mono counties, but only in small quantities. The only commercial production

recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County. Recovery of bismuth from blister copper in the electrolytic refinery has been noted. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining of lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems in electric fuses, and in solders.

Present quotations for bismuth are around 85¢ per pound, in ton lots for the refined metal.

CADMIUM

Bibliography: U. S. Geol. Surv., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only, commercial production of cadmium recorded from Californian ore. Cadmium occurs there associated with zinc sulphide, sphalerite. Cadmium also occurs in the Cerro Gordo Mines, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute proportions, the average ratio being about 1 of cadmium to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are 55¢ per pound for the refined metal.

COBALT

Bibliography: Report XIV. Bulletins 67, 91. U. S. G. S., Min. Res. of U. S., 1912, 1918. U. S. B. M., I. C. 6331.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial production has resulted. Some of the copper ores of the foothill copper belt in Mariposa and Madera counties have been found to contain cobalt up to 3%. The most notable occurrence thus far found in this State is in the

Mar-John Mine near Sheep Ranch, Calaveras County. Lenses of smaltite ($CoAs_2$), have been uncovered in the vein, there, and several tons taken out in the course of development work; but as yet there have been no commercial shipments.

The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

The nominal quotation for cobalt is around $2.50 per pound for the refined metal.

COPPER

Bibliography: State Mineralogist Reports VIII–XXVII (inc.). Bulletins 23, 50, 91.

Copper is second to gold among the metals mined in California. The output during 1931 amounted to a total of 12,954,842 pounds of recoverable metal valued at $1,178,890. This was a decrease in both amount and value from the 1930 figures, which were 26,534,752 pounds and $3,449,522. The average price of copper for 1931 was 9.1 cents per pound compared with 13 cents in 1930, 17.6 cents in 1929 and 14.4 cents in 1928.

Plumas County ranked first, as it has for several years past, in the production of copper for 1931 with an output of 12,473,960 pounds and was the only county with over a million pounds output.

Distribution of the 1931 output in California by counties was as follows:

County	*Pounds*	*Value*
Butte	2,108	$192
Calaveras	184	17
Inyo	8,542	777
Kern	207	19
Napa	1,945	177
Nevada	143,984	13,103
Plumas	12,473,960	1,135,130
Riverside	401	36
San Bernardino	6,072	553
Santa Barbara	7,135	650
Shasta	309,314	28,148
Amador, El Dorado, Mariposa, Merced, Placer, and Tuolumne*	990	88
Totals	12,954,842	$1,178,890

* Combined to conceal the output of a single operator in each.

Copper Production of the United States.

According to preliminary data issued by the U. S. Bureau of Mines,[1] the smelter production of primary copper from domestic sources during 1931 amounted to 1,042,711,178 pounds, a decrease of approximately 25 per cent compared with 1930 output. The value decreased approximately 48 per cent in 1931. The average price of 1,836,993,000 pounds of copper delivered during the year, as reported to the U. S. Bureau of Mines by selling agents, was 9.1 cents per pound.

[1] U. S. Bureau of Mines, Press Bulletin, June 7, 1932.

"REFINED COPPER

The total production of new refined copper in 1931 was 1,501,000,000 pounds, a decrease of 656,000,000 pounds from that in 1930."

Primary and secondary copper produced by regular refining plants and imported, 1930–1931, in pounds

	1930	1931
Primary:		
Domestic:[1]		
Electrolytic	1,228,416,733	947,065,977
Lake	142,985,522	105,222,177
Casting	19,821,950	22,317,887
	1,391,224,205	1,074,606,041
Foreign:[1]		
Electrolytic	765,189,037	426,307,093
Casting	645,936	529,199
Refinery production of new copper	2,157,059,178	1,501,442,333
Imports of refined copper	86,210,331	174,449,893
Total new refined copper made available	2,243,269,509	1,675,892,226
Secondary:		
Electrolytic	279,423,370	156,099,339
Casting	1,106,114	28,914
	280,529,484	156,128,253
	2,523,798,993	1,832,020,479

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation of the amounts at this stage of manufacture is not possible.

In addition to their output of metallic copper the regular refining companies produced bluestone (hydrous copper sulphate) having a copper content of 8,983,000 pounds, as compared with 9,419,000 pounds in 1930.

STOCKS

Stocks of copper January 1, 1928, 1929, 1930, 1931, and 1932, in pounds

Year	Refined copper	Blister and material in process of refining[1]
1928	171,000,000	401,000,000
1929	114,000,000	423,000,000
1930	306,000,000	500,000,000
1931	615,000,000	450,000,000
1932	924,600,000	348,000,000

[1] The amounts stated in the last column in the table above do not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States.

CONSUMPTION

The new refined copper withdrawn from the total year's supply on domestic account in the United States in 1931 and the method employed in determining it are shown in the following table, which does not include stocks of copper held by consumers.

New refined copper withdrawn from total year's supply on domestic account, 1930–1931, in pounds

	1930	1931
Total supply of new copper	2,243,269,509	1,675,892,226
Stock at beginning of year	306,000,000	615,000,000
Total available supply	2,549,269,509	2,290,892,226
Copper exported[1]	669,252,807	464,227,033
Stock at end of the year	615,000,000	924,600,000
	1,284,252,807	1,388,827,033
Withdrawn on domestic account	1,265,016,702	902,065,193

[1] Includes refined copper in ingots, bars, rods, or other forms.

Copper Production of California, by Years.

Although some mining of copper ores in a small way had been done earlier, shipments in appreciable quantities began in 1861 and con-

tinued of importance up to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or 'regulus'[1] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity in Calaveras County, with some shipments also made from Mariposa, El Dorado, Fresno and San Luis Obispo counties. From 1868 to 1882, the output was insignificant. There are wide discrepancies in the figures currently recorded for copper production previous to 1882, in which year the data of the U. S. Geological Survey began. The detailed statistics of the California State Mining Bureau began in the year 1894.

Amount and value of copper production in California annually since 1882 is given in the following tabulation:

Copper Production of California, by Years

Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1908	40,868,772	$5,350,777
1883	1,600,862	265,743	1909	65,727,736	8,478,142
1884	876,166	120,911	1910	53,721,032	6,680,641
1885	469,028	49,248	1911	36,838,024	4,604,753
1886	430,210	43,021	1912	34,169,997	5,638,049
1887	1,600,000	192,000	1913	34,471,118	5,343,023
1888	1,570,021	235,303	1914	30,491,535	4,055,375
1889	151,505	18,180	1915	40,968,966	7,169,567
1890	23,347	3,502	1916	55,809,019	13,729,017
1891	3,397,405	424,675	1917	48,534,611	13,249,948
1892	2,980,944	342,808	1918	47,793,046	11,805,883
1893	239,682	21,571	1919	22,162,605	4,122,246
1894	738,594	72,486	1920	12,947,299	2,382,303
1895	225,650	21,901	1921	12,088,053	1,559,358
1896	1,992,844	199,519	1922	22,883,987	3,090,582
1897	13,638,626	1,540,666	1923	28,346,860	4,166,989
1898	21,543,229	2,475,168	1924	52,089,349	6,823,704
1899	23,915,486	3,990,534	1925	46,968,499	6,669,527
1900	29,515,512	4,748,242	1926	33,521,544	4,693,014
1901	34,931,788	5,501,782	1927	27,350,316	3,582,888
1902	27,860,162	3,239,975	1928	25,162,304	3,623,360
1903	19,113,861	2,520,997	1929	33,809,258	5,941,799
1904	29,974,154	3,969,995	1930	26,534,752	3,449,522
1905	16,997,489	2,650,605	1931	12,954,842	1,178,890
1906	28,726,448	5,522,712			
1907	32,602,945	6,341,387	Totals	1,142,156,177	$182,046,960

[1] Brown, J. Ross, Mineral Resources West of the Rocky Mountains, p. 168, 1867.

GOLD

Bibliography: State Mineralogist Reports I to XXVIII (inc.), (except III and VIII). Bulletins 36, 45, 57, 91, 92, 95. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first, and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement beginning with 1920, it still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska. In fact, at present, California is producing approximately 22% of the gold mined in the entire United States.

The gold yield has decreased in recent years, not only in California but in the country as a whole. Meanwhile, the actual gold reserves (monetary stock on hand) of the United States has increased to such an extent that we now hold practically one-half of the world's stock.

There has been a steady increase in the development of both lode and placer mines in California and elsewhere during the last four or

Steam shovel and sluices on Dry Creek, near Stanfield Hill, Yuba County.
Photo by Walter W. Bradley

Washing gravel on a bar in the Yuba River, near Smartsville, Yuba County.
Photo by Walter W. Bradley

five years, brought about by the present economic conditions. During 1931 there were 959 operators in California, not including snipers, prospectors and various individuals selling gold in small lots to the bullion dealers. It is estimated that there were 10,000 to 15,000 of the latter class operatng in the State, most of which were people who could not find employment in other lines. As a whole these people made an average of not to exceed 50c. a day.

The production of gold in California for 1931 totaled 523,135.09 fine ounces worth $10,814,162, being an increase of 65,935.11 fine ounces over the 1930 yield. The deep or lode mines output accounted for 328,631.49 fine ounces worth $6,793,416 and the placers (mainly dredges) produced 194,503.60 fine ounces worth $4,020,746.

As the Division of Mines has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. V. C. Heikes of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest production for 1931 was reported from Nevada County, with an output of 159,870.40 fine ounces ($3,304,815); Sacramento County second with 90,519.04 fine ounces ($1,871,195); Amador County third with 74,936.39 fine ounces ($1,549,073); followed in turn by Yuba, Sierra, Shasta, Plumas and Trinity counties. Nevada held the first place as a gold producing county with an output exceeding that of Yuba or Amador which held first and second places respectively in 1928 with Sacramento fourth that year. Sacramento held second place in 1931, its output exceeding that of Amador, which held second place in 1930. The gold from Yuba and Sacramento comes almost entirely from dredges, while that from Nevada and Amador counties comes mainly from the lode mines.

Distribution of the 1931 gold output by counties was as follows:

County	Number of operators[a]	Value
Alpine	1	$16
Amador	35	1,542,073
Butte	40	172,383
Calaveras	60	152,771
Del Norte	12	1,372
El Dorado	54	85,322
Fresno	10	6,512
Humboldt	9	2,678
Imperial	4	649
Inyo	20	40,603
Kern	63	202,108
Lassen	2	241
Los Angeles	5	1,292
Madera	12	2,405
Mariposa	38	88,600
Merced	2	173,551
Modoc	1	293
Mono	9	125,342
Monterey	1	148
Napa	1	14,766
Nevada	63	3,304,815
Placer	66	72,409
Plumas	36	308,443
Riverside	7	2,524
Sacramento	20	1,871,195
San Bernardino	39	54,699
San Diego	7	3,988
San Luis Obispo	1	1,549
Santa Barbara	1	81
Shasta	32	331,165
Sierra	42	651,954
Siskiyou	92	74,326
Stanislaus	7	154,443
Trinity	64	292,031
Tulare	2	244
Tuolumne	68	77,902
Ventura	1	293
Yuba	32	991,976
Totals	959	$10,814,162

[a] Number does not include snipers, prospectors, and various individuals selling small lots to bullion dealers.

The following is quoted from the advanced statement of gold in 1931 by courtesy of the U. S. Bureau of Mines,[b] Department of Commerce:

"The total recoverable gold in ore and gravels treated in California in 1931, according to Victor C. Heikes of the U. S. Bureau of Mines, was valued at $10,814,162, of which 462 lode mines yielded $6,793,416 and 497 placers (including dredges) $4,020,746. Compared with the gold yield in 1930 this was an increase of $1,363,000 with the lode mines showing the larger increase in output. Of the total gold yield in 1931 lode mining produced 63 per cent and placer mining 37 per cent. Only three counties had a production of gold exceeding $1,000,000 and these, in order of rank, were Nevada, Sacramento, and Amador. Of the lode gold output gold ore and tailings yielded nearly 95 per cent; copper ore, etc., 4 per cent; an lead and copper-lead-zinc ores 1 per cent. Of the placer gold output dredges yielded 90 per cent, surface placers over 5 per cent, drift placers nearly 3 per cent, and hydraulic placers over 1 per cent. The gold output of 22 dredges (24 in 1930) was 5 per cent more than in the preceding year. Twenty-nine companies in the State produced more than 1000 ounces of gold each and contributed 90 per cent of the total gold output."

"* * * Gold from lode mines increased, with practically all of the larger gold mines showing a gain in output, but it is not expected that the ratio between the output of the lode mines and the placer mines will be as large as in 1930, when lode mines produced 60 per cent and the placer mines 40 per cent of the total gold output of the State. Increased activity in the dredging field in Sacramento County offset the declining yield of the dredges in Yuba County, the remaining two important gold-dredging fields of the State. Gold from copper ore mined in Plumas County and the gain in small lots of placer bullion produced by the increased number of miners, due to unemployment in other industries, were important factors in the total output of the State, which maintained its rank as the leading gold-producing State. Three gold-bearing quartz mines on the Mother Lode, in Amador County, and three mines in the Grass Valley-Nevada City region are the deepest operating mines in California; they produced 40 per cent of the total output of the State in 1931, compared with 40 per cent in 1930. The gold from the six mines in the two regions increased 16 per cent. Gold produced from copper ores represented about 3 per cent of the total output of gold, but decreased 27 per cent compared with the 1930 production, due to the cessation of mining copper ore by two large companies in the State,

[b] U. S. Bureau of Mines, Department of Commerce advanced statement for 1931 and Press Bull. Jan. 18, 1932.

one of which, the Mountain Copper Co. (Ltd.), turned to the mining of the gold-bearing gossan, capping its copper ore deposit.

"Deep mining in Amador and Nevada counties continued to open up rich shoots of gold-bearing quartz on the lower levels of several mines. In Nevada County the Empire Star Mines Co. (Ltd.), a Newmont subsidiary, opened up several new shoots of ore and added more territory to its holdings. Present development and exploration work at the property is on the 2700 and 4200-foot levels. The company employs about 650 men at its three shafts, the Empire, Pennsylvania, and North Star, and its two reduction plants, with 140 stamps, treated ore by amalgamation, gravity concentration, cyanidation, and flotation. The Idaho Maryland Consolidated Mines (Inc.) operated its property continuously, but no work was undertaken in the Brunswick, Union Hill, and other mines of the company. Flotation equipment replaced the gravity concentrators at the Brunswick 20-stamp mill and operations began in January. In October the Idaho-Maryland mill was similarly equipped. Both mills in 1931 crushed 45,000 tons of ore up to the end of October, with a gross recovery of $574,573 in gold and silver, or an average of $12.77 a ton. At the Murchie mine, of the American Foundation Co., preparations were made for a sorting plant and larger primary crushing machinery. The flotation mill at present is treating 160 tons of ore a day, operating two shifts. The ore contains about three ounces of silver to one of gold and, like the ore of the Idaho-Maryland, the quartz carries some galena and chalcopyrite. Development of the 1300-foot level has opened two orebodies.

"In Amador County the Argonaut Mining Co., at Jackson, continued to extend a winze to the 6200-foot level. Drafts were driven on the 5800-foot level along the ore shoot recently discovered, which is supplying a considerable part of 220 tons of ore a day to the amalgamation-gravity concentration mill. The Kennedy Mining & Milling Co. completed its equipment of Krout flotation cells and the ore feed of 20 stamps was under treatment the latter part of the year. The Kennedy mine is opened to a depth of 4650 feet by a vertical shaft and an incline shaft 4800 feet. The Central Eureka Mining Co., near Sutter Creek, operated its 40-stamp amalgamation and gravity concentration plant on ore derived from below the 1200-foot level of the Old Eureka property.

"Exploration work was continued in the Bodie field, Mono County, by the Treadwell Yukon Co. (Ltd.) and, although its working force was diminished, the company continued to operate its two mills.

"In Trinity County the Trinity, Lewiston, and Madrone dredges were in operation. The Yuba Consolidated Gold Fields operated 3 boats in the Hammonton field and 1 boat in Merced County, the Capital Dredging Co. 3 boats in the Folsom field, and the Natomas Co. 6 boats in the Natoma field. The La Grange Gold Dredging Co. operated its dredge near La Grange, in Stanislaus County.

"Prospectors and small gold producers were given aid by the Director of the Mint, who lowered the regulation amount of $100 to 2 ounces (about $40) and over of gold that will be accepted at the different United States Mints and assay offices during the present season only. The regulation is not permanent. During the time the regulation has been in force at the San Francisco Mint, the work in handling deposits of bullion was almost doubled."

Total Gold Production of California.

The presence of gold in stream gravels near Los Angeles was known and worked in a small way by the Indians, at least as early as 1841,[1] and possibly 1820.[2] On March 2, 1844, Don Manuel Castanares, deputy for California to the Congress of Mexico, reported[3] to his government that placers near Los Angeles had produced up to December, 1843, a total of 2000 ounces of gold dust, most of which had been sent to the United States Mint at Philadelphia.

As the padres and the rancheros discouraged the quest of gold, this early, small production caused no particular excitement. It was not until James W. Marshall's finding of gold nuggets in the tail-race of Sutter's saw mill on the American River, January 24, 1848, was heralded abroad that the great rush began, and California became a commonwealth of first rank almost over night. There are, however, no authentic data on gold production prior to 1848, other than occasional, scattered references such as above quoted.

The following table was originally compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the

[1] Hittell, T. H., History of California, Vol. II, p. 312, 1885.
[2] Bancroft, H. H., History of California, Vol. II, p. 417, 1886.
[3] Mercantile Trust Review of the Pacific, Vol. XIV, No. 2, p. 43, Feb. 15, 1925.

U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to who were alive at the time of the original compilation of this table in 1894 were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures for 1903–1923 (inclusive) are those prepared by the U. S. Geological Survey; and since by the U. S. Bureau of Mines:

Total Gold Production of California

Year	Value	Year	Value
1848	$245,301	1891	$12,728,869
1849	10,151,360	1892	12,571,900
1850	41,273,106	1893	12,538,780
1851	75,938,232	1894	13,863,282
1852	81,294,700	1895	15,334,317
1853	67,613,487	1896	17,181,562
1854	69,433,931	1897	15,871,401
1855	55,485,395	1898	15,906,478
1856	57,509,411	1899	15,336,031
1857	43,628,172	1900	15,863,355
1858	46,591,140	1901	16,989,044
1859	45,846,599	1902	16,910,320
1860	44,095,163	1903	16,300,653
1861	41,884,995	1904	18,633,676
1862	38,854,668	1905	18,898,545
1863	23,501,736	1906	18,732,452
1864	24,071,423	1907	16,727,928
1865	17,930,858	1908	18,761,559
1866	17,123,867	1909	20,237,870
1867	18,265,452	1910	19,715,440
1868	17,555,867	1911	19,738,908
1869	18,229,044	1912	19,713,478
1870	17,458,133	1913	20,406,958
1871	17,477,885	1914	20,653,496
1872	15,482,194	1915	22,442,296
1873	15,019,210	1916	21,410,741
1874	17,264,836	1917	20,087,504
1875	16,876,009	1918	16,528,953
1876	15,610,723	1919	16,695,955
1877	16,501,268	1920	14,311,043
1878	18,839,141	1921	15,704,822
1879	19,626,654	1922	14,670,346
1880	20,030,761	1923	13,379,013
1881	19,223,155	1924	13,150,175
1882	17,146,416	1925	13,065,330
1883	24,316,873	1926	11,923,481
1884	13,600,000	1927	11,671,018
1885	12,661,044	1928	10,785,315
1886	14,716,506	1929	8,526,703
1887	13,588,614	1930	9,451,162
1888	12,750,000	1931	10,814,162
1889	11,212,913		
1890	12,309,793	Total value	$1,852,470,356

IRIDIUM (see under Platinum)

IRON ORE

Bibliography: State Mineralogist Reports II, IV, V, X, XII–XV (inc.), XVII, XVIII, XXI–XXVII (inc.). Bulletins 38, 67, 91. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123, pp. 94–96, 113–114.

A small tonnage of iron ore was mined in California during the year 1931. The material was hematite and came from San Bernardino County. As there was only a single operator, the figures are concealed in the 'Unapportioned' item. The 1930 output was magnesite and came from Santa Cruz County. It was obtained by magnetic separation of beach sand and utilized in the manufacture of wear-resisting alloys. There was also a tonnage utilized in the manufacture of paint pigments and which is credited to "mineral paint" in this statistical report.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside, San Bernardino and Los Angeles counties, but production has so far been limited for lack of an economic supply of coking coal. Some pig iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction; also, ferrochrome, ferromanganese, and ferrosilicon have been made in California.

Total Iron Ore Production of California.

Total iron ore production of California, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1915	724	$2,584
1882	2,073	17,766	1916	3,000	6,000
1883	11,191	106,540	1917	2,874	11,496
1884	4,532	40,983	1918	3,108	15,947
1885			1919	2,300	13,796
1886	3,676	19,250	1920	5,975	40,889
1887			1921	1,970	12,030
1893	250	2,000	1922	3,588	18,868
1894	200	1,500	1923	3,102	18,665
1895			1924	785	4,710
1907	400	400	1925[a]		
1908			1926	5,272	26,000
1909	108	174	1927[a]		
1910	579	900	1928		
1911	558	558	1930	[a]	[a]
1912	2,508	2,508	1931	[a]	[a]
1913	2,343	4,485			
1914	1,436	5,128	Totals	71,805	$552,629

* Productions for the years 1881-1886 (inc.) were reported as "tons of pig iron" (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Hotaling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

[a] Annual details concealed under 'Unapportioned.'

LEAD

Bibliography: State Mineralogist Reports IV, VIII–XV (inc.), XVII–XXVII (inc.).

The production of lead in California during 1931 was 3,934,240 pounds of recoverable metal valued at $145,568, as compared with the

1930 figures which were 3,524,796 pounds and $176,241. The average price of lead in 1931 was 3.7 cents per pound; in 1930 was 5 cents per pound; and in 1929 was 6.3 cents per pound.

Distribution of the 1931 output by counties was as follows:

County	*Pounds*	*Value*
Calaveras	4,386	$162
Inyo	3,703,232	137,020
Kern	6,307	283
Los Angeles	2,245	83
Mono	137	5
Nevada	198,671	7,351
Riverside	1,939	72
San Bernardino	15,763	585
Amador, El Dorado, Mariposa, Plumas, Sacramento, and Shasta*	1,560	57
Totals	3,934,240	$145,568

* Combined to conceal the output of a single operator in each.

Lead Production of the United States.

According to preliminary data issued by the U. S. Bureau of Mines [1] during 1931, the production of primary lead in the United States was 390,260 short tons, valued at $28,897,000, being a decrease from the national production of 1930 which was 573,740 short tons worth $57,374,000, due to decreased selling price of lead from an average of 6.3 cents a pound in 1929 to 5.0 cents in 1930, and 3.7 cents in 1931.

Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Total Production of Lead in California, by Years

Year	Pounds	Value	Year	Pounds	Value
1877	[a] 7,836,000	$391,800	1905	533,680	$25,083
1878	8,640,000	328,320	1906	338,718	19,307
1879	4,502,000	191,335	1907	328,681	16,690
1880	4,200,000	215,460	1908	1,124,483	46,663
1881	6,680,000	325,316	1909	2,685,477	144,897
1882	[b] 4,000,000	196,800	1910	3,016,902	134,082
1883	[c] 3,400,000	145,520	1911	1,403,839	63,173
1884	3,200,000	120,512	1912	1,370,067	61,653
1885	2,000,000	80,900	1913	3,640,951	160,202
1886	2,000,000	93,400	1914	4,697,400	183,198
1887	[d] 1,160,000	52,200	1915	4,796,299	225,426
1888	900,000	38,250	1916	12,392,031	855,049
1889	940,000	35,720	1917	21,651,352	1,862,016
1890	800,000	36,000	1918	13,464,869	956,006
1891	1,140,000	49,020	1919	4,139,562	219,397
1892	1,360,000	54,400	1920	4,903,738	392,300
1893	666,000	24,975	1921	1,149,051	51,707
1894	950,000	28,500	1922	6,511,280	358,120
1895	1,592,400	49,364	1923	9,934,522	695,416
1896	1,293,500	38,805	1924	4,984,387	398,751
1897	596,000	20,264	1925	7,352,422	639,661
1898	655,000	23,907	1926	8,067,873	645,429
1899	721,000	30,642	1927	2,748,440	173,151
1900	1,040,000	41,600	1928	1,882,795	109,102
1901	720,500	28,820	1929	1,428,777	90,014
1902	349,440	12,230	1930	3,542,796	176,241
1903	110,000	3,960	1931	3,934,240	11,145,568
1904	124,000	5,270			
			Totals	193,600,472	$11,511,592

[a] Quantities for 1877–1881 (inc.) from C. E. Siebenthal, Mineral Resources of U. S. 1912, Part I, U. S. Geol. Survey, p. 339; and values for same years from quotations in Eng. & Min. Jour. of New York.

[b] Estimated.

[c] Quantities and values for 1883–1886 (inc.) from Mineral Resources of U. S. Geol. Surv., 1883–1886, respectively.

[d] Data from 1887 to date from reports of California State Mining Bureau.

[1] U. S. Bureau of Mines, Press Bull. June 8, 1932.

MANGANESE

Bibliography: State Mineralogist Reports XII-XV (inc.), XVIII, XXII–XXVII (inc.). Bulletins 38, 67, 76, 91. U. S. G. S., Bull. 427. Eng. & Min. Jour.-Press, Vol. 117, p. 545.

During 1931 there was a small production of manganese ore in California which came from San Bernardino County. This material was utilized as an alloy of steel and for the manufacture of fertilizer, and contained 37% Mn. The annual details are concealed in the 'Unapportioned' item so as not to reveal the output of a single operator.

Importations[1] of foreign manganese ore into the United States during 1931, mainly from Soviet Russia and Brazil, amounted to a total of 562,821 short tons valued at $5,104,590 compared with 655,836 tons worth $6,476,802 in 1930.

The Tariff Act of 1930 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore (including ferruginous manganese ore) or concentrates containing in excess of 10 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

Much valuable research work has been done in recent years, particularly by companies operating in Montana and Virginia, in the beneficiation of manganese ores. The success of their processes appears assured. In reply to the suggestions of certain steel interests to have the manganese import duty removed, the manganese operators organized the American Manganese Producers' Association, which actively worked for retention of the tariff. Such retention will enable the domestic industry to grow and to further develop ore-dressing methods that will make available large tonnages of low-grade material not now marketable.

Manganese Ore Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows California's ouput

[1] U. S. Bureau of Foreign and Domestic Commerce, Monthly Summary, Dec., 1931.

of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1910	265	$4,235
1888	1,500	13,500	1911	2	40
1889	53	901	1912	22	400
1890	386	3,176	1913		
1891	705	3,830	1914	150	1,500
1892	300	3,000	1915	4,013	49,098
1893	270	4,050	1916	13,404	274,601
1894	523	5,512	1917	15,515	396,659
1895	880	8,200	1918	26,075	979,235
1896	518	3,415	1919	11,569	451,422
1897	504	4,080	1920	2,892	62,323
1898	440	2,102	1921	1,005	12,210
1899	295	3,165	1922	540	7,650
1900	131	1,310	1923	690	10,620
1901	425	4,405	1924	1,115	25,785
1902	870	7,140	1925	832	19,450
1903	1	25	1926	235	4,700
1904	60	900	1927		
1905			1928*	733	8,216
1906	1	30	1929*		
1907	1	25	1930*	207	2,576
1908	321	5,785	1931*		
1909	3	75	Totals	88,451	$2,394 346

* Annual details concealed under 'Unapportioned.'

MOLYBDENUM

Bibliography: State Mineralogist Reports XIV, XVII–XXIV (inc.), XXVI, XXVII. Bulletins 67, 91. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and -breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland and Norway, with some also from Canada; but the United States is now able to supply its own requirements.

The growing consumption of molybdenum by alloy-steel makers in the United States has been stimulated by the fact that molybdenum alone of the steel-alloying metals can be produced commercially in the United States to an extent which avoids all necessity for importation. Another fact has been the marked adaptability of molybdenum steels to large-scale production of automobile and other parts.

The most important development of 1924-1925 was the elimination of ferromolybdenum from the market due to the substitution of calcium molybdate as the furnace addition by the entire alloy-steel industry. Calcium molybdate is stated to be not only easier and less costly to prepare, but it introduces the molybdenum into the steel bath in a

much purer form, the resulting steel being superior to that made with ferromolybdenum.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war 1916-1918. Some development work has been recently done on a high-grade deposit at the head of the Kaweah River, Tulare County.

The Tariff Act of 1930 provides for an import duty of 35 cents a pound for the metallic molybdenum content of molybdenum ores or concentrates.

The present quotations on molybdenum ores are 42¢ per pound of MoS_2 contained, delivered at Pittsburgh, Pa., and on ferromolybdenum are 95¢ per pound Mo, 50%-60% Mo f.o.b. shipping point.

Molybdenum Production of California, by Years.

California's production of molybdenum ore by years is summarized in the following tabulation:

Year	*Tons*	*Value*
1916	8	$9,945
1917	243	9,014
1918	*	300
Totals	251	$19,259

* 300 pounds of 90% MoS_2 concentrate.

NICKEL

Bibliography: State Mineralogist Reports XIV, XVII, XXIV, XXV. U. S. G. S., Bulletin 640-D. U. S. Bureau of Standards, Circular 100.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are around 35¢-36¢ per pound for the refined metal.

OSMIUM (see under Platinum)

PALLADIUM (see under Platinum)

PLATINUM

Bibliography: State Mineralogist Reports IV, VIII, IX, XII-XXVI (inc.). Bulletins 38, 45, 67, 85, 91, 92. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Ins. Min. Eng., Vol. 47, pp. 217–218.

In California the platinum group metals are obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Amador, Butte, Sacramento, Stanislaus, Shasta

and Yuba counties, with a small amount coming from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Siskiyou and Trinity counties.

The production of the platinum-group metals in California during 1931 totaled 351 ounces crude, containing 305 fine ounces valued at $11,979, compared with 217 fine ounces worth $11,700 in 1930. This metal came from properties in Butte, Calaveras, Humboldt, Sacramento, Shasta, Siskiyou, Stanislaus, Trinity, and Yuba counties. Of the above 305 fine ounces, 198 ounces were platinums, 49 ounces were iridium, 48 ounces were osmium and 10 ounces were palladium and ruthenium.

Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowledge as to which lot of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

Uses, Markets and Consumption.

Besides its well known uses in jewelry, dentistry and for chemicalware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

According to the U. S. Bureau of Mines, Department of Commerce,[1] the total consumption of platinum metals in the United States in 1931 was 119,197 fine ounces, an increase over that consumed in 1929, distributed as follows:

PLATINUM METALS SOLD BY REFINERS IN THE UNITED STATES, 1930 AND 1931, BY CONSUMING INDUSTRIES, IN TROY OUNCES

Industry	*Platinum*	*Palladium*	*Iridium*	*Others*	*Total*	*Per cent of total*
1930						
Chemical	15,022	854	34	49	15,959	13
Electrical	8,529	8,569	864	70	19,032	16
Dental	11,810	15,436	111	6	27,363	23
Jewelry	44,801	2,807	2,407	526	50,541	43
Miscellaneous	3,324	1,621	208	876	6,029	5
Totals	83,486	30,287	3,624	1,527	118,924	100
1931						
Chemical	11,483	979	18	64	12,544	11
Electrical	8,215	22,628	609	17	31,469	26
Dental	10,135	9,394	74	13	19,616	17
Jewelry	41,261	2,988	2,185	264	46,698	39
Miscellaneous	5,896	1,934	373	667	8,870	7
Totals	76,990	37,923	3,259	1,025	119,197	100

[1] U. S. Bureau of Mines, Dept. of Commerce Press Bulletin, July 6, 1931.

STOCKS

The stock of platinum metals in the hands of refiners at the end of 1931 (88,485 ounces) was virtually the same as at the end of 1930.

STOCKS OF PLATINUM METALS IN THE HANDS OF REFINERS IN THE UNITED STATES, DECEMBER 31, 1922–1931, IN TROY OUNCES

Year	*Platinum*	*Palladium*	*Iridium*	*Others*	*Total*
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539
1925	44,024	26,740	3,720	4,609	79,093
1926	64,203	31,950	3,933	5,485	105,571
1927	68,757	24,313	4,617	4,369	102,056
1928	45,710	23,018	4,523	5,019	78,270
1929	51,853	20,154	4,716	5,461	82,184
1930	52,853	18,978	8,828	8,006	88,665
1931	51,231	17,553	10,193	9,508	88,485

Prices.

The prices of all the metals of the platinum-group fluctuate more or less during 1931 according to quotations.[1] Refined platinum started 1931 at $36 per fine ounce, during February to the end of April there were several reductions in price down to $23 per fine ounce. In May the price increased to $27.50 per fine ounce, and again in June to $40 per fine ounce, at which price it ended the year. The quotations on 98 and 99 per cent iridium, sponge and powder began the year at $180 to $200 an ounce with several reductions during the year to end it at $90 to $100 an ounce. Osmium varied between $60 and $70 per ounce; ruthenium between $38 to $65 per ounce; and palladium between $19 to $22 per ounce.

Platinum Production of California, by Years.

The annual production and values since 1887 have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	416	$10,400	1910	337	$8,386
1888	100	400	1911	511	14,873
1889	500	2,000	1912	603	19,731
1890	500	2,000	1913	368	17,738
1891	600	2,500	1914	463	14,816
1892	100	500	1915	667	21,149
1893	80	440	1916	886	42,642
1894	75	517	1917	610	43,719
1895	100	600	1918	571	42,788
1896	150	900	1919	*418	60 611
1897	162	944	1920	477	68,977
1898	150	900	1921	613	58,754
1899	300	1,800	1922	795	90,288
1900	300	1,800	1923	602	78,546
1901	400	2,500	1924	273	36,452
1902	250	3,200	1925	292	39,937
1903	39	468	1926	322	32,005
1904	70	1,052	1927	139	10,749
1905	123	1,849	1928	312	27,902
1906	200	3,320	1929	212	14,416
1907	91	1,647	1930	217	11,700
1908	300	6,255	1931	305	11,979
1909	706	13,414			
			Totals	15,699	$827,564

* Fine ounces, beginning with 1919.

[1] Metal and Mineral Markets, Vol. 2, 1931.

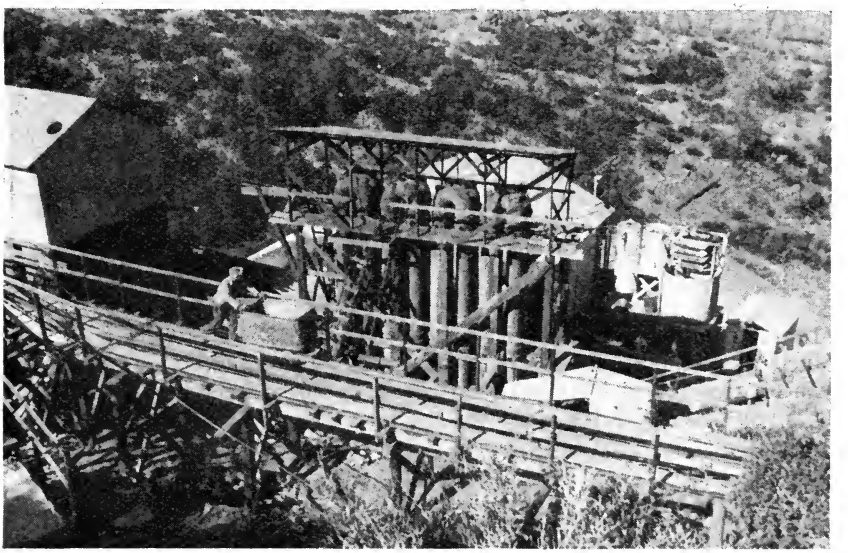
QUICKSILVER

Bibliography: State Mineralogist Reports IV, V, XII-XV, XVII-XXVII (inc.). Bulletins 27, 78, 91. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96, 227; Bulletin 222, 335.

The production of quicksilver in California during 1931 was 13,478 flasks valued at $1,121,624. This showed an increased amount with a decreased value from the 1930 output, which was 11,374 flasks worth $1,255,257. The distribution of the 1931 output of quicksilver by counties was as follows:

County	*Flasks*	*Value*
Lake	3,046	$251,879
Napa	1,937	168,710
San Benito	4,120	349,619
San Luis Obispo	2,574	202,870
Sonoma	449	39,392
Colusa, Fresno, Kern, Kings, Inyo, Santa Barbara, Santa Clara, Siskiyou, Trinity *	1,352	109,154
Totals	13,478	$1,121,624

* Combined to conceal output of a single operator in each.



Cast-iron condensers at Rinconada Quicksilver Mine, San Luis Obispo County.

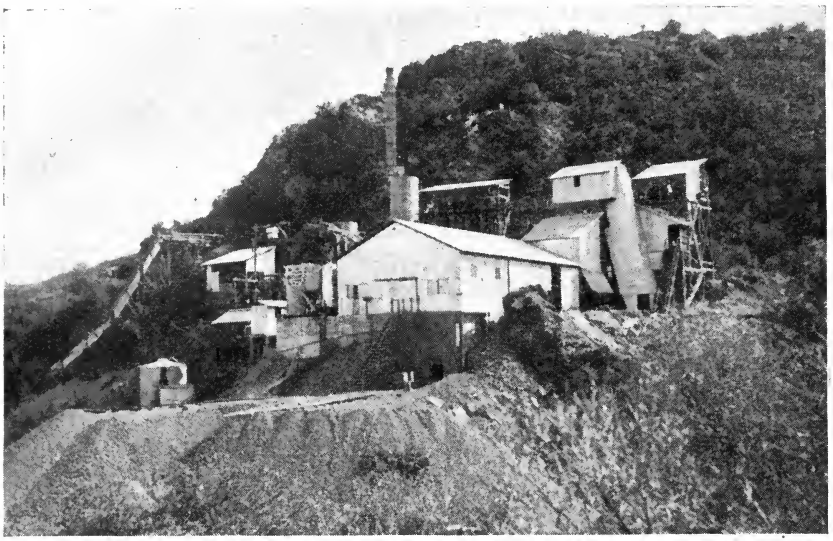
Photo by Walter W. Bradley

Prices.

During 1931 the average monthly New York quotations [1] were $87.35 for a 76-pound flask, compared with $115 in 1930. The price at the beginning of the year was $104 per flask and during the year the quotations fluctuated, with a general downward trend, ending the year at $66 a flask. The average amount received by producers in California during 1931, according to reports received by the Division of Mines, was $83.22 for a 76-pound flask, compared with $110.36 per flask in 1930, $117.78 per flask in 1929.

[1] Metal and Mineral Market, Vol. 2, 1931.

The United States Bureau of Mines[1] reported the total production of the United States for 1931 at 24,750 flasks, valued at $2,162,000. California was by a wide margin the largest producing State with approximately 54% of the total. The other producing states, in order of their output, were Oregon, Nevada, Texas, Washington, Arizona, and Arkansas. The national production in 1930 was 21,553 flasks worth $2,478,789.



Rinconada Quicksilver Mine, San Luis Obispo County.

Photo by Walter W. Bradley

In 1931 imports of quicksilver into the United States were 356 flasks valued at $32,649, of which 350 flasks came from Spain and 6 flasks from Mexico. The 1931 imports were a decrease from 1930 when 2943 flasks were received in the United States and in 1929 14,292. The Tariff Act of 1930 provided an import duty of 25 cents per pound on quicksilver.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electrical appliances, of scientific apparatus, pigments and cosmetics. By far the greatest consumption is in the manufacture of fulminate and drugs. Radio tubes, Neon and mercury lights and electrical appliances are taking increasing amounts.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, are shown in the following tabulation. Though the New Almaden Mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846

[1] U. S. Bureau of Mines, Dept. of Comm., Press Bull., April 8, 1932.

(the yield being small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds; then 75 pounds up to and including 1927; beginning with 1928, of 76 pounds. In compiling this table the following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10.

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1892	27,993	$1,139,595	$40 71
1851	27,779	1,859,248	66 93	1893	30,164	1,108,527	36 75
1852	20,000	1,166,600	58 33	1894	30,416	934,000	30 70
1853	22,284	1,235,648	55 45	1895	36,104	1,337,131	37 04
1854	30,004	1,663,722	55 45	1896	30,765	1,075,449	34 96
1855	33,000	1,767,150	53 55	1897	26,691	993,445	37 28
1856	30,000	1,549,500	51 65	1898	31,092	1,188,626	38 23
1857	28,204	1,374,381	48 73	1899	29,454	1,405,045	47 70
1858	31,000	1,482,730	47 83	1900	26,317	1,182,786	44 94
1859	13,000	820,690	63 13	1901	26,720	1,285,014	48 46
1860	10,000	535,500	53 55	1902	29,552	1,276,524	43 20
1861	35,000	1,471,750	42 05	1903	32,094	1,335,954	42 25
1862	42,000	1,526,700	36 35	1904	[a] 28,876	1,086,323	37 62
1863	40,531	1,705,544	42 08	1905	24,655	886,081	35 94
1864	47,489	2,179,745	45 90	1906	19,516	712,334	36 50
1865	53,000	2,432,700	45 90	1907	17,379	663,178	38 16
1866	46,550	2,473,202	53 13	1908	18,039	763,520	42 33
1867	47,000	2,157,300	45 90	1909	16,217	773,788	47 71
1868	47,728	2,190,715	45 90	1910	17,665	799,002	45 23
1869	33,811	1,551,925	45 90	1911	19,109	879,205	46 01
1870	30,077	1,725,818	57 38	1912	20,600	866,024	42 04
1871	31,686	1,999,387	63 10	1913	15,661	630,042	40 23
1872	31,621	2,084,773	65 93	1914	11,373	557,846	49 05
1873	27,642	2,220,482	80 33	1915	14,199	1,157,449	81 52
1874	27,756	2,919,376	105 18	1916	21,427	2,003,425	93 50
1875	50,250	4,228,538	84 15	1917	24,382	2,396,466	98 29
1876	75,074	3,303,256	44 00	1918	22,621	2,579,472	114 03
1877	79,396	2,961,471	37 30	1919	15,200	1,353,381	89 04
1878	63,880	2,101,652	32 90	1920	10,278	775,527	75 45
1879	73,684	2,194,674	29 85	1921	3,157	140,666	44 56
1880	59,926	1,857,706	31 00	1922	3,466	191,851	55 35
1881	60,851	1,815,185	29 83	1923	5,458	332,851	60 98
1882	52,732	1,488,624	28 23	1924	7,948	543,080	68 33
1883	46,725	1,343,344	28 75	1925	7,683	621,831	80 81
1884	31,913	973,347	30 50	1926	5,892	516,382	87 64
1885	32,073	986,245	30 75	1927	6,488	714,418	111 67
1886	29,981	1,064,326	35 50	1928	[b] 7,107	844,649	118 84
1887	33,760	1,430,749	42 38	1929	10,152	1,195,705	117 78
1888	33,250	1,413,125	42 50	1930	11,374	1,255,257	110 36
1889	26,464	1,190,880	45 00	1931	13,478	1,121,624	83 22
1890	22,926	1,203,615	52 50				
1891	22,904	1,036,406	45 25	Totals	2,268,030	$114,179,154	

[a] Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.
[b] Flasks of 76 pounds, from January, 1928.

SILVER

Bibliography: State Mineralogist Reports IV, VIII, XII-XXVII (inc.). Bulletins 67, 91. Min. & Sci. Press, March 1, 1919.

The 1931 silver production in California totaled 867,818 fine ounces valued at $251,667, as compared with the 1930 output of 1,622,803 fine ounces worth $624,779. Of the 1931 yield there were 13,214 fine ounces worth $3,932 coming from the placers. The average price of domestic silver was 29 cents per fine ounce in 1931 at New York for 1931, compared with 38.5 cents per fine ounce in 1930, 53.3 cents in 1929, and 58.5 cents per fine ounce in 1926.

Distribution of the 1931 silver production by counties was as follows:

County	*Fine ounces*	*Value*
Alpine	44	$13
Amador	16,494	4,783
Butte	2,240	650
Calaveras	3,410	989
Del Norte	4	1
El Dorado	976	283
Fresno	53	15
Humboldt	18	5
Imperial	8	2
Inyo	142,452	41,311
Kern	8,739	2,534
Lassen	6	2
Los Angeles	222	64
Madera	38	11
Mariposa	1,893	551
Merced	778	226
Modoc	6	2
Mono	18,524	5,372
Napa	60,009	17,403
Nevada	150,384	43,611
Placer	935	271
Plumas	322,317	93,472
Riverside	44	13
Sacramento	3,641	1,056
San Bernardino	111,908	32,453
San Diego	51	15
San Luis Obispo	2	1
Santa Barbara	6	2
Shasta	9,712	2,816
Sierra	5,728	1,661
Siskiyou	583	169
Stanislaus	768	223
Trinity	1,835	532
Tulare	6	2
Tuolumne	622	180
Ventura	9	3
Yuba	3,345	970
Totals	867,818	$251,667

The following paragraphs are quoted from the United States Bureau of Mines, Department of Commerce, Advanced Chapter on Gold and Silver for 1931 by courtesy of Mr. V. C. Heikes, statistician in charge of the San Francisco Branch office:

"The mine production of silver in California in 1931 was 867,818 fine ounces, valued at $251,667, a decrease of 754,985 ounces in quantity and $373,112 in value compared with 1930. No company produced more than 500,000 ounces, only 3 more than 100,000 ounces, 2 between 50,000 and 100,000 ounces, and 19 with less than 50,000 ounces each. The chief silver-producing counties in 1931 were Plumas, Nevada, Inyo, and San Bernardino, each with an output of between 100,000 and 350,000 ounces, followed by Napa with an output of slightly over 60,000 ounces and Mono and Amador each with an output of over 10,000 and under 20,000 ounces. Of the total silver output from lode mines dry silver ore yielded 110,621 ounces of 13 per cent, copper ore, etc., 322,148 ounces or 38 per cent, gold ore and tailings 202,937 ounces or 24 per cent, lead ore 141,691 ounces or 17 per cent, gold and silver ore 60,009 ounces or 7 per cent, and copper-lead-zinc ore 17,198 ounces or 2 per cent. The yield of silver from placer mines was 13,214 ounces, valued at $3,832.

"The three gold-bearing quartz producing mines in Amador County, the Argonaut, Kennedy, and Central Eureka, and the three in the Grass Valley-Nevada City region, the Empire Star, Idaho-Maryland, and Murchie, yielded approximately 17 per cent of the total silver and approximately 20 per cent more than their yield in 1930. The Wortley Consolidated Mines Co. operated the former large silver-producing mine, the Kelly Rand, in the Randsburg district, San Bernardino County, during January and February, and was succeeded by the Red Mountain Mines Syndicate. Here, as at some other silver properties, gold-bearing material has been found between the oxide and sulphide zones that can be treated by flotation and the tailings by cyanidation. The flotation plant now treats about 75 tons of ore a day, including company ore, and lessees and purchased ores and tailings from the King Solomon property."

Silver Production of California, by Years.

The amount and value of the silver production of California, and the average price, annually, since 1880 are given in the table following. In the table shown in the statistical bulletins previous to Bulletin 97

(for 1925), the values shown for 1880–1904 (inc.) were taken from the reports of the Director of the Mint, of which the figures for 1880-1896 (inc.) were based on 'coinage value' ($1.2929 per fine ounce). We have recalculated these to commercial value, using the price table of the U. S. Geological Survey (McCaskey, H. D., Gold and Silver, 1913: Mineral Resources of the U. S., Part I, p. 847). From 1905 to date, the figures are those of the U. S. Geological Survey and its successor, the U. S. Bureau of Mines:

Silver Production of California, by Years, Since 1880

Year	Fine oz.	Value	Average price per oz.	Year	Fine oz.	Value	Average price per oz.
1880	882,169	$1,014,494	$1 15	1907	1,138,856	$751,646	$0 66
1881	580,091	655,503	1 13	1908	1,647,278	873,057	53
1882	653,569	745,069	1 14	1909	2,098,253	1,091,092	52
1883	1,129,244	1,253,461	1 11	1910	1,840,085	993,646	54
1884	3,236,987	3,593,056	1 11	1911	1,270,445	673,336	53
1885	1,986,260	2,125,298	1 07	1912	1,300,136	799,584	615
1886	1,245,747	1,233,290	0 99	1913	1,378,399	832,553	604
1887	1,262,282	1,237,036	0 98	1914	1,471,859	813,938	553
1888	1,314,874	1,235,982	0 94	1915	1,678,756	851,129	507
1889	823,947	774,510	0 94	1916	2,564,354	1,687,345	658
1890	820,336	861,353	1 05	1917	1,775,431	1,462,955	824
1891	737,224	729,852	0 99	1918	1,427,711	1,427,711	1 00
1892	358,575	311,960	87	1919	1,107,189	1,240,051	1 12
1893	415,468	324,065	78	1920	1,706,327	1,859,896	1 09
1894	229,896	144,834	63	1921	3,629,223	3,629,223	1 00
1895	463,911	301,542	65	1922	3,100,065	3,100,065	1 00
1896	326,757	222,195	68	1923	3,559,443	2,918,743	82
1897	754,648	452,789	60	1924	3,555,133	2,381,952	67
1898	701,788	414,055	59	1925	3,054,416	2,119,765	694
1899	855,869	513,521	60	1926	2,022,460	1,262,015	624
1900	1,168,157	724,257	62	1927	1,620,242	918,677	567
1901	950,831	570,499	60	1928	1,478,771	865,081	585
1902	1,163,041	616,412	53	1929	1,176,895	627,285	533
1903	958,230	517,444	54	1930	1,622,803	624,779	385
1904	1,441,259	835,929	58	1931	867,818	251,667	290
1905	1,076,174	650,009	61				
1906	1,220,641	817,830	68	Totals	74,850,323	$56,933,436	

TIN

Bibliography: Reports XV, XVII, XVIII, XXV. Bulletins 67, 91.

In 1928 and 1929 there was a small amount of tin produced from Californian ore as well as considerable development work which was done at the Temescal mine in Riverside County near Corona.

There was an output from the district during 1891–1892 as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets have been taken out.

On March 12, 1929, the new tin plating plant of the Columbia Steel Corporation at Pittsburg, Contra Costa County, California, started operation. This is the first tin plate mill west of St. Louis. This mill has an annual capacity of 38,000 tons of tin plate per year and will give the Pacific Coast a local source for their tin plate.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies),

followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Wales, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by detinning scrap and old cans.

Total Output of Tin in California

Year	*Pounds*	*Value*
1891	125,289	$27,564
1892	126,000	32,400
1928 }	*	*
1929 }		
Totals	251,289	$59,964

* Annual details concealed under 'Unapportioned.'

TITANIUM

Bibliography: State Mineralogist's Report XXIII.

During 1931 there was no production of titanium ores reported in California. In 1927 the first recorded shipments of titanium minerals were made in California. The total of the 1927 and 1928 production was 10,013 tons valued at $150,195. All of this came from Los Angeles County and was produced from either the black beach sands, which probably contained approximately 20% titaniferous iron and magnetite, the gangue being silica and several silicates, or from a lode deposit in the San Gabriel Mountains.

Titanium is widely distributed in a variety of minerals, but its commercial sources are limited to three forms, rutile (oxide), ilmenite (titanite), and titaniferous magnetite (iron ore rich in titanium). There are several known areas where large deposits of these minerals are found in America, mostly titaniferous iron. Of the titaniferous iron deposits only a portion of the Adirondack deposit, some small deposits in North and South Carolina, and those in Los Angeles County are capable of being separated into a high-grade ilmenite and a low titanium magnetite.

The metal is used in several different alloys with iron, copper and aluminum and for green and white paint pigments, the only colors of titanium pigments now in common use. It is also used in dyes, rubber, as a porcelain glaze, in glass, and cement made from high-titanium iron slags. This cement is resistant to the action of acids.

The market price of titanium minerals varies as to the titanium oxide it contains. Rutile 94% TiO at 10¢ a pound, ilmenite 45 to 52% TiO at $10 to $12 a ton, and ilmenite 32 to 35% TiO at $7 to $8 a ton, all prices Atlantic seaboard.

TUNGSTEN

Bibliography: Reports XV, XVII, XVIII, XXII, XXIV, XXVII (inc.). Bulletins 38, 67, 91, 95. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc., Vol. XI, South Dakota School of Mines. Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack

of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and regained its pre-war average annual tonnage in 1926, although each year thereafter showed a decreased yield. The material shipped in 1931 included both high-grade sorted ore and concentrates and came from a single property in San Bernardino County. The annual details are concealed under the 'Unapportioned' item so as not to reveal the output of a single shipper. Besides the above there was some tungsten ore mined, but not shipped, in El Dorado, Inyo, and Tulare counties.

Quotations [1] during 1931 ranged from $10 to $12 per unit of WO_3 for Chinese wolframite; $10.50 to $12 per unit for WO_3 for Bolivian scheelite; and $9.50 to $12.50 for domestic scheelite. The highest prices were at the beginning of the year. Present prices per unit WO_3 at New York are $10 to $10.25 for Chinese wolframite; $10 for Bolivian scheelite; and $9 to $10 for domestic scheelite.

Imports of foreign tungsten ores and alloys into the United States during 1931, according to the U. S. Bureau of Foreign and Domestic Commerce, was 2,111,298 pounds worth $246,201, compared with 3,613,832 pounds valued at $1,658,890 in 1930; and 10,362 long tons of ore valued at $11,409,237 in 1918, which ores were duty free up to September 22, 1922. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines and low market prices, practically all of the tungsten mines in the United States were closed down from the middle of 1919 to the latter part of 1923. Quotations during 1922 ranged around $2.50 per unit, up to September of that year when the tariff was placed on the ore. The Tariff Act of 1930 raised the duty on tungsten ore or concentrates to 50 cents per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys. Most of the imported ore is coming from China, with smaller amounts from Malay and Bolivia.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of California's tungsten ore is sheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[2] and the output has in some years equaled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent.

Uses.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would

[1] Metal and Mineral Markets, 1931, Vol. 2.
[2] U. S. G. S. Bull. 652, p. 32.

lose its temper—hence the name 'high speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included. Tungsten compounds are used in the manufacture of colors. The indicated consumption is approximately 5000 tons of 60% concentrates per year, in the United States.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3267° C. (5913° F.), being higher than any other known metal. Though millons of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Total Tungsten Ore Production of California.

The annual amount and value of tungsten ores and concentrates produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	1918	1,982	$2,832,222
1906	485	189,100	1919	214	219,316
1907	287	120,587	1920		
1908	105	37,750	1923	34	19,126
1909	577	190,500	1924	781	446,009
1910	457	208,245	1925	573	348,475
1911	387	127,706	1926	441	316,560
1912	572	206,000	1927*		
1913	559	234,673	1928*	398	429,237
1914	420	180,575	1929	150	106,280
1915	962	1,005,467	1930*		
1916	2,270	4,571,521	1931*	120	82,582
1917	2,466	3,079,013	Totals	14,297	$14,969,740

* Annual details concealed under 'Unapportioned.'

VANADIUM

Bibliography: Report XV, XXVI. Bulletins 67, 91. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Some ore carrying lead vanadate has been developed in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties, but no shipments reported.

The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present New York quotations for ferrovanadium are $3.16–$3.50 per pound of vanadium f. o. b. works, and vanadium ore 28¢ per pound V_2O_5 contained.

ZINC

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XX–XXIV, XXVI, XXVII. Bulletins 38, 67, 91.

The recoverable zinc mined in California during 1931 amounted to 149,865 pounds valued at $5,314. This material was a flotation concentrate coming as a by-product at a gold mine in Nevada County. At present, owing to the low price of zinc and the distance required to ship the concentrates to a smelter, it is not profitable to mine the ore. During the last period of production most of California's zinc concentrates were shipped to Belgium for smelting, although a small amount has been made into zinc oxide here in the state. The American zinc smelters are located along the Mississippi River or on eastern seaboard, with electrolytic zinc plants in both Idaho and Montana.

The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo, Los Angeles and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20% a large portion is rolled into plates and sheets and utilized in the building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

The production of slab zinc [1] at reduction plants in the United States in 1931 amounted to 313,621 short tons at $23,825,000, and 21,625 tons of redistilled secondary metal. The 1931 production was a decrease from that of 1930 which was 523,894 tons for United States only.

The average price per pound quoted for the metal in 1931 was 3.8¢ as compared with 4.8¢ in 1930 and 6.5¢ in 1929.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1919	1,384,192	$101,046
1907	177,759	10,598	1920	1,188,009	96,229
1908	54,000	3,544	1921	846,184	42,309
1909			1922	3,034,430	172,963
1910			1923		
1911	2,679,842	152,751	1924	3,060,000	198,900
1912	4,331,391	298,866	1925	11,546,602	877,542
1913	1,157,947	64,845	1926	20,447,559	1,533,568
1914	399,641	20,381	1927	8,625,004	552,000
1915	13,043,411	1,617,383	1928		
1916	15,950,565	2,137,375	1929		
1917	11,854,804	1,209,190	1931	149,865	5,314
1918	5,565,516	506,466			
			Totals	105,702,769	$9,613,836

[1] U. S. Bureau of Mines, Department of Commerce. Press Bulletin, March 5, 1932.

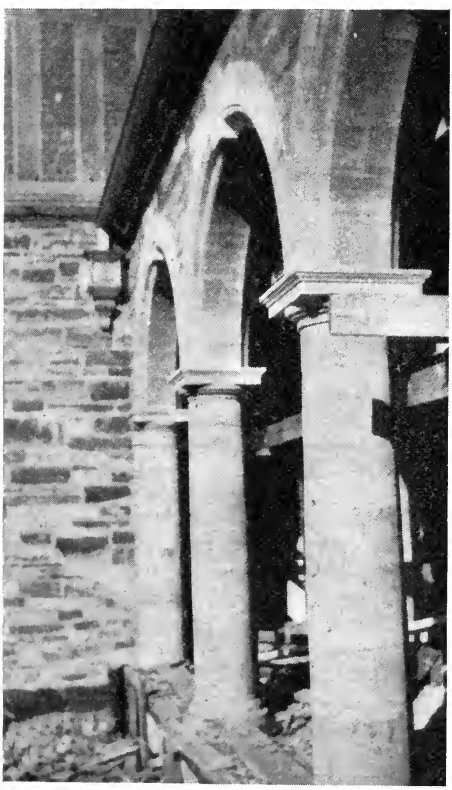
CHAPTER FOUR

STRUCTURAL MATERIALS

Bibliography: State Mineralogist Reports XII–XXVIII (inc.). Bulletin 38. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state.

This branch of the mineral industry for 1931 was valued at $27,303,449, as compared with a total value of $37,098,700 for the year 1930, the decrease being mainly due to miscellaneous stone, cement, brick and hollow building tile, and all other materials in this group, with the exception of bituminous rock, and chromite. The last-mentioned showed increases in both amount and total value.



Doorway of carmel stone from quarries of Arthur H. Anthony, Carmel, Monterey County.

Photo by Arthur H. Anthony

The 1927 output established a record for this type of material in both quantity and total value which was $54,861,649, exceeding all other years in total value records.

Crushed rock production is yearly more worthy of consideration, due to the strides taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, and in 1923 showed advances to new figures, with a steady recession from 1924 to 1931. This item will, no doubt, con-

tinue to be an important one, and a market for fire and fancy brick of all kinds will unquestionably never be lacking.

In 1931 all counties, with the exception of Sutter, contributed to this structural total. There is not a county in the fifty-eight counties of the state which is not capable of producing at least one of the materials under the classification and in 1926 every county contributed one or more substances to the group.

During 1931 building construction in California continued on a downward trend as shown in a survey[1] made covering 51 California cities. In these cities building permits showed an average decline of approximately 36.0 per cent from the previous year.

The following summary shows the value of the structural materials produced in California during the years 1930–1931, with increases or decreases in each instance:

Substance	1930		1931		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Bituminous rock	8,525 tons	$36,075	*	*	*
Brick and hollow building tile		4,205,460		$2,560,415	$1,645,045—
Cement	9,831,938 bbls.	14,575,731	7,693,712 bbls.	11,510,655	3,065,076—
Chromite	80 tons	1,905	441 tons	6,737	4,832+
Granite		855,477		636,741	218,736—
Lime	47,622 tons	452,084	36,189 tons	360,523	91,561—
Magnesite	38,681 tons	388,472	21,576 tons	182,283	206,189—
Marble[a]		82,194		81,760	434—
Sandstone		56,404		30,960	25,444—
Stone, miscellaneous		16,403,027		11,848,531	4,554,496—
Unapportioned		[b]41,871		[c]84,844	42,973+
Total values		$37,098,700		$27,303,449	
Net decrease					$9,795,251

* Included under 'Unapportioned.'
[a] Includes onyx and travertine.
[b] Includes slate, paving blocks and tube-mill pebbles.
[c] Includes bituminous rock, slate, paving blocks and tube-mill pebbles.

ASPHALT

Bibliography: State Mineralogist Reports VII, X, XII–XV (inc.), XVII, XVIII. Bulletins 16, 32, 63, 67, 69, 91.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

[1] California State Chamber of Commerce, Economic Survey Report No. 19, Series 1931 and 1932.

BITUMINOUS ROCK

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XXI, XXII, XXV, XXVI.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent, probably the residue from the evaporation of a crude petroleum deposit. Bituminous rock is still used to a limited extent for road dressing in those districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost entirely superseded the direct use of the native material. Some of the Santa Cruz County production is put on the market as a material which can be laid cold. This material is especially applicable and valuable for patch jobs.

During 1931 shipments of bituminous rock were made from Santa Barbara and Santa Cruz counties with a single producer in each. The annual details are concealed under the 'Unapportioned' item so as not to reveal the output of either operator. The 1931 production was an increase in both quantity and value over that of 1930, which was 8525 short tons valued at $36,075.

Bituminous Rock Production of California, by Years.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1910	87,547	$165,711
1888	50,000	257,000	1911	75,125	117,279
1889	40,000	170,000	1912	44,073	87,467
1890	40,000	170,000	1913	37,541	78,479
1891	39,962	154,164	1914	66,119	166,618
1892	24,000	72,000	1915	17,789	61,468
1893	32,000	192,036	1916	19,449	66,561
1894	31,214	115,193	1917	5,590	18,580
1895	38,921	121,586	1918	2,561	9,067
1896	49,456	122,500	1919	4,614	18,537
1897	45,470	128,173	1920	5,450	27,825
1898	46,836	137,575	1921	8,298	43,192
1899	40,321	116,097	1922	4,624	13,570
1900	25,306	71,495	1923	2,945	11,780
1901	24,052	66,354	1924	6,040	14,922
1902	33,490	43,411	1925	2,681	10,724
1903	21,944	53,106	1926	3,863	21,577
1904	45,280	175,680	1927	3,515	17,704
1905	24,753	60,436	1928	4,966	33,832
1906	16,077	45,204	1929	3,320	14,360
1907	24,122	72,835	1930	8,525	36,075
1908	30,718	109,818	1931	*	*
1909	34,123	116,436			
			Totals	1,208,680	$3,766,427

* Annual details concealed under 'Unapportioned.'

BRICK AND HOLLOW TILE

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII–XXVII (inc.). Bulletins 38, 99. Preliminary Report, No. 7. Cal. Jour. of Development, June, 1925, pp. 5–6.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diver-

sified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain products are shipped over a much wider radius. So far as possible, the different kinds have been segregated in the tabulation herewith accompanying.

We also include under this heading the various forms of hollow building 'tile' or blocks. The application of these tile to residence construction as well as to other structures has grown, although their total output for 1931 showed a decrease in value and tonnage as compared with the 1930 production.

The value of the 1931 output of all kinds of brick showed a decrease in their total values of about 42 per cent and in amount about 44 per cent.

Brick and Hollow Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for hollow building 'tile' or blocks being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	*Brick, M*	*Hollow building blocks, tons*	*Value*
1893	103,900	------	$801,750
1894	81,675	------	457,125
1895	131,772	------	672,360
1896	24,000	------	524,740
1897	97,468	------	563,240
1898	100,102	------	571,362
1899	125,950	------	754,730
1900	137,191	------	905,210
1901	130,766	------	860,488
1902	169,851	------	1,306,215
1903	214,403	------	1,999,546
1904	281,750	------	1,994,740
1905	286,618	------	2,273,786
1906	277,762	------	2,538,848
1907	362,167	------	3,438,951
1908	332,872	------	2,506,495
1909	333,846	------	3,059,929
1910	340,883	------	2,934,731
1911	327,474	------	2,638,121
1912	337,233	------	2,940,290
1913	358,754	------	2,915,350
1914	270,791	------	2,288,227
1915	180,538	------	1,678,756
1916	206,960	------	2,096,570
1917	192,269	29,348	2,532,721
1918	136,374	34,818	2,363,481
1919	156,328	36,026	3,087,067
1920	245,842	99,208	5,704,393
1921	238,022	67,100	5,570,875
1922	374,853	105,909	7,994,991
1923	397,754	122,534	9,738,082
1924	456,716	114,469	9,137,908
1925	361,094	105 491	7,503,976
1926	388,048	90,332	7,026,124
1927	374,111	75,116	6,516,077
1928	272,443	66,277	5,694,770
1929	327,011	66,713	5,607,410
1930	267,019	68,047	4,205,460
1931	151,545	51,988	2,560,415
Totals	9,554,155	1,133,376	$127,965,310

Brick and Hollow Building Tile for 1931, by Counties

County	Common		Fire		Glazed, pressed, fancy, vitrified, paving		Hollow building tile or blocks		Total value
	M	Value	M	Value	M	Value	Tons	Value	
Alameda	*	*	*	*	1,398	$54,248	*	*	$54,248
Los Angeles	80,278	$609,202	3,878	$237,682	1,437	60,466	11,537	$95,357	1,002,707
Sacramento	8,406	121,325	*	*	*	*	*	*	121,325
Santa Clara	7,862	81,982			*	*			81,982
Alameda, Amador, Butte, Contra Costa, Fresno, Humboldt, Kern, Marin, Orange, Placer, Riverside, San Bernardino, San Diego, San Joaquin, San Luis Obispo, Santa Barbara, Tulare and Ventura*	33,041	329,751							329,751
Alameda, Amador, Contra Costa, Fresno, Placer, Riverside, Sacramento, San Diego and San Joaquin*			10,975	472,654					472,654
Contra Costa, Placer, Riverside, Sacramento, Santa Barbara, Santa Clara and Ventura*					4,270	173,110			173,110
Alameda, Contra Costa, Fresno, Placer, Riverside, Sacramento, San Diego, San Joaquin, San Luis Obispo, Santa Barbara, Tulare and Ventura*							40,451	324,638	324,638
Totals	129,587	$1,142,260	14,853	$710,336	7,105	$287,824	51,988	$419,995	$2,560,415

* Combined to conceal the output of a single operator in each.

CEMENT

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII, XVIII, XXI–XXVII (inc.). Bulletin 38.

Cement is the most important single structural material in the mineral output of California. During 1931 there was a production of 7,693,712 barrels of cement valued at $11,510,655 f.o.b. plant, being a decrease in both quantity and value from the preceding years. The 1930 output was 9,831,938 barrels worth $14,575,731, or an average value of $1.48 per barrel. The average value per barrel in 1931 was $1.49.

The 1931 production came from ten plants operating in nine counties and employing a total of 1496 men. Two plants were in operation in San Bernardino County and a single plant in each of the following counties: Calaveras, Contra Costa, Kern, Los Angeles, Merced, Riverside, San Mateo and Santa Barbara.

There has been an interesting parallelism in the output of the Portland cement and the crushed rock, sand and gravel industries in California. The use of concrete has been a most important development in structural work during the last 20 or 30 years, and has made possible the building of such great monolithic structures as our irrigation and hydro-electric power dams, as well as highway pavements and skyscraper office buildings.

Cement Production of California, by Years.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

"The Benicia Cement Company in 1859–60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12,000 barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."[1]

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield beginning with 1920 has since annually exceeded the value of her gold output.

[1] Monthly Review of Mercantile Trust Co. of Cal . Vol. XIII, No. 3, p. 55, Mar., 1924.

Cement Production of California, by Years

Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1912	6,198,634	$6,074,661
1892	5,000	15,000	1913	6,167,806	7,743,024
1893			1914	5,109,218	6,558,148
1894	8,000	21,600	1915	4,918,275	6,044,950
1895	16,383	32,556	1916	5,299,507	6,210,293
1896	9,500	28,250	1917	5,790,734	7,544,282
1897	18,000	66,000	1918	4,772,921	7,969,909
1898	50,000	150,000	1919	4,645,289	8,591,990
1899	60,000	180,000	1920	6,709,160	14,962,945
1900	52,000	121,000	1921	7,404,221	18,072,120
1901	71,800	159,842	1922	8,962,135	16,524,056
1902	171,000	423,600	1923	10,825,405	25,999,203
1903	640,868	968,727	1924	11,655,131	23,225,850
1904	969,538	1,539,807	1925	13,206,630	25,043,335
1905	1,265,553	1,791,916	1926	13,797,173	25,269,678
1906	1,286,000	1,941,250	1927	14.661,783	26.474.935
1907	1,613,563	2,585,577	1928	13 625.231	24,463.287
1908	1,629,615	2,359,692	1929	12,794,729	21,038,565
1909	3,779,205	4,969,437	1930	9,831 938	14 575 731
1910	5,453,193	7,185,715	1931	7,693,712	11,510,655
1911	6,371,369	9,085,625			
			Totals	197,545,219	$337,838,201

CHROMITE

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII, XVIII, XXI–XXVII (inc.). Bulletins 38, 76, 91. Preliminary Report 3. U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic-iron ore or chromite, recalculated to the basis of 45 per cent Cr_2O_3, amounting to 441 short tons valued at $6,737 f.o.b. rail shipping point was sold in California during 1931. This was an increase over the 1930 figures, which were 84 tons and $1,905. This material came from properties in El Dorado, Fresno, Placer, and Tuolumne counties, in addition there was a property each in Placer, San Luis Obispo, and Shasta counties which mined chromite, but did not ship any during the year. The grade of the material shipped varied from 17 per cent (which was concentrated) to 55 per cent Cr_2O_3.

The political and commercial control of chromite now rests largely with England, through the ownership and sales contracts exercised by the Chrome Company (Ltd.), of London. That company controls both the Rhodesian and the New Caledonian output.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1830 to 1870 the deposits in Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the

Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proved to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons were shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promise well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production of California came from that source.

Imports.

Imports of foreign chromite [1] duty free, mainly from Rhodesia, New Caledonia and India, totaled 212,528 long tons valued at $3,314,776 for the year 1931, compared with 330,531 tons worth $3,513,123 in 1930.

Uses.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals, the latest development of which is chrome plating as used in the automobile industry, on ships, and in oil refineries to protect metal surfaces from wear and erosion. It is stated that during the last five years, the sales of chromite brick and chromite cement have increased 500%, because of their replacing magnesite which is more expensive.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

[1] Monthly Summary of Foreign Commerce of U. S. Bureau of Foreign and Domestic Commerce, Part 1, Dec., 1931.

Total Chromite Production of California

Year	Tons	Value	Year	Tons	Value
1874–1876 (San Luis Obispo County)	26,028	$329,924	1909	436	$5,309
1887	3,000	40,000	1910	749	9,707
1888	1,500	20,000	1911	935	14,197
1889	2,000	30,000	1912	1,270	11,260
1890	3,599	53,985	1913	1,180	12,700
1891	1,372	20,580	1914	1,517	9,434
1892	1,500	22,500	1915	3,725	38,044
1893	3,319	49,785	1916	48,943	717,244
1894	3,680	39,980	1917	52,379	1,130,298
1895	1,740	16,795	1918	73,955	3,649,497
1896	786	7,775	1919	*4,314	97,164
1897			1920	1,770	43,031
1898			1921	347	6,870
1899			1922	379	6,334
1900	140	1,400	1923	84	1,658
1901	130	1,950	1924	350	6,700
1902	315	4,725	1925	191	3,712
1903	150	2,250	1926	393	7,063
1904	123	1,845	1927	225	5,063
1905	40	600	1928	729	15,179
1906	317	2,859	1929	327	5,025
1907	302	6,040	1930	84	1,905
1908	350	6,195	1931	441	6,737
			Totals	245,116	$6,463,869

* Recalculated to 45% Cr_2O_3, beginning with 1919.

GRANITE

Bibliography: State Mineralogist Reports X, XII–XXVI (inc.). Bulletin 38.

The value of the granite output in California during 1931 was $636,741 (this included a small amount of tuff and some flow volcanic rocks which were used for flagstones). This was a decrease from the 1930 production which was valued at $855,477.

So far as possible, granite production has been segregated in the table herewith into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'Unclassified' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of uniform texture and color, especially suited for monumental and ornamental work.

Granite Production, by Counties, for 1931

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic ft.	Value	Cubic ft.	Value	Linear ft.	Value	Cubic ft.	Value	
Fresno			8,077	$59,549	*	*			$59,549
Placer	57	$86	2,003	4,214			*	*	4,300
Sacramento	6,767	12,181					75	$135	12,316
San Diego	20	20	4,089	10,172					10,192
Shasta	[b]373	950							950
Madera, San Luis Obispo[a], and Tulare*	217,487	384,082							384,082
Lassen, Madera, Plumas, Riverside and Tulare*			82,082	156,025					156,025
Fresno and Plumas*					950	$3,500			3,500
Los Angeles[b], Mariposa, Placer, Sonoma[b] and Ventura[b]*							19,480	5,827	5,827
Totals	224,704	$397,319	96,251	$229,960	950	$3,500	19,555	$5,962	$636,741

* Combined to conceal output of a single operator in each.
[a] Tuff used for building stone.
[b] Volcanic rock used as building stone and flagstone.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1910	$417,898
1888	57,000	1911	355,742
1889	1,329,018	1912	362,975
1890	1,200,000	1913	981,277
1891	1,300,000	1914	628,786
1892	1,000,000	1915	227,928
1893	531,322	1916	535,339
1894	228,816	1917	221,997
1895	224,329	1918	139,861
1896	201,004	1919	220,743
1897	188,024	1920	495,732
1898	147,732	1921	725,901
1899	141,070	1922	676,643
1900	295,772	1923	760,081
1901	519,285	1924	1,211,046
1902	255,239	1925	1,853,859
1903	678,670	1926	655,332
1904	467,472	1927	1,398,143
1905	353,837	1928	763,996
1906	344,083	1929	1,169,271
1907	373,376	1930	855,477
1908	512,923	1931	636,741
1909	376,834		
		Totals	$26,170,874

LIME

Bibliography: Reports XIV, XV, XVII–XXVII (inc.). Bulletin 38.

In California during 1931 there was an output of lime to the amount of 36,189 short tons valued at $360,523, coming from two plants each in El Dorado, San Bernardino, Santa Cruz counties and one each in Inyo, San Benito, and Tuolumne counties. The above amount was a decrease in both quantity and value from the 1930 production which was 47,662 tons valued at $452,084.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Lime Production of California, by Years.

The following tabulation gives the amounts and value of lime produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. The figures for quantity have been recalculated from 'barrels' to 'tons' for the years 1894–1922 (inc.);

Lime Production of California, by Years

Year	Tons	Value	Year	Tons	Value
1894	37,350	$318,700	1914	43,996	$378,663
1895	39,776	386,094	1915	35,653	286,304
1896	30,275	261,505	1916	49,364	390,475
1897	28,780	252,900	1917	50,073	311,380
1898	29,786	254,010	1918	43,684	461,315
1899	29,985	314,575	1919	42,070	552,043
1900	31,252	283,699	1920	46,314	557,232
1901	31,738	334,688	1921	46,353	610 619
1902	44,866	369,616	1922	57,875	671,747
1903	49,659	418,280	1923	70,894	788,834
1904	57,945	571,749	1924	62,029	703,355
1905	61,700	555,322	1925	61,922	685,528
1906	68,927	763,060	1926	63,568	670,837
1907	68,422	756,376	1927	60,498	631,497
1908	39,639	379,243	1928	56,616	547.919
1909	52,075	577,824	1929	42,834	417,101
1910	47,951	477,683	1930	47,662	452.084
1911	42,959	390,988	1931	36,189	360,523
1912	52,212	464,440			
1913	61,344	528,547	Totals	1,824,215	$18,136,755

MAGNESITE

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXVII (inc.). Bulletins 38, 79, 91. U. S. Geol. Surv. Bulletins 355, 540. Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17, and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444. Eng. & Min. Jour.-Press, Vol. 114, July 29, and Dec. 2, 1922. U. S. Tariff Comm., "Crude and Caustic Calcined Magnesite. A Preliminary Statement of Information," May 19, 1926.

The production of magnesite during the year 1931 amounted to a total of 21,576 tons of crude ore valued at $182,283. Only a small part of this was sold crude, however, as it was practically all shipped in the calcined form. The reports at hand show a total of 8781 short tons shipped calcined valued at $298,722 rail shipping point. Of the above, 21 per cent was dead-burned and periclase for refractory purposes, the balance going to the plastic trade. This material came from Santa Clara, Stanislaus and Tulare counties with a single producer in each. From 2 to 2½ tons of crude material are mined to make one ton of calcined.

The 1931 output showed a decrease in both quantity and value from the 1930 figures, which were 38,681 short tons worth $388,472. The average value of the crude magnesite reported for 1931 was $8.45 per ton compared with $10.04 in 1930; $10.32 in 1929, $11 in 1928 and $12.50 in 1927.

Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide), and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2 as calcite has but 44%.

Most of the Californian magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture

resembling a break in porcelain. The Grecian magnesite is largely of this character; but the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and the Sierra Nevada, being associated with serpentine areas. The notable exceptions are the sedimentary deposits at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomite limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, recent experience has proved that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces.

Uses.

The principal uses include: Refractory linings for basis open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proved particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes, the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface. It has also a very strong bonding power, and will hold firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

For refractory purposes the calcined magnesite is largly made up into bricks similar to fire-brick for furnace linings. It is also used unconsolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows a slight sintering in forming the brick. Dead-burned, pure magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Pure magnesite which is fused to a hard flint-like mass called 'artificial periclase,' will not shrink with additional heat and is used as a refractory for high temperatures.

Before the World War, practically all of the domestic output of caustic magnesite was used in the manufacture of pulp and paper. For this purpose calcined dolomite is now used. The use of dolomite instead of magnesite by the paper manufacturers began during the war when the price of magnesite was very high. Dolomite was found to be a good substitute for magnesite in the bisulphite process of paper making and so its use has continued.

Imports.

The tariff act of 1930 placed the following import duties on magnesite: Crude magnesite $\frac{1}{2}\frac{5}{2}¢$ per lb., caustic-calcined magnesite $\frac{1}{1}\frac{5}{6}¢$ per lb.; dead-burned and grain magnesite, not suitable for manufacture into oxychloride cements, $^{23}/_{40}¢$ per lb; magnesite brick $\frac{3}{4}¢$ per lb. and 10% ad valorem. The figures of imports for 1931, as published by the U. S. Bureau of Foreign and Domestic Commerce, show a total of 23,405 short tons valued at $391,315, as compared with 51,195 tons worth $789,624 in 1930.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

Total Magnesite Production of California

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1910	16,570	$113,887
1888	600	9,000	1911	8,858	67,430
1889	600	9,000	1912	10,512	105,120
1890	600	9,000	1913	9,632	77,056
1891	1,500	15,000	1914	11,438	114,380
1892	1,500	15,000	1915	30,271	283,461
1893	1,093	10,930	1916	154,052	1,311,893
1894	1,440	10,240	1917	209,648	1,976,227
1895	2,200	17,000	1918	83,974	803,492
1896	1,500	11,000	1919	44,696	452,094
1897	1,143	13,671	1920	83,695	1,033,491
1898	1,263	19,075	1921	47,837	511,102
1899	1,280	18,480	1922	55,637	594,665
1900	2,252	19,333	1923	73,963	946,643
1901	4,726	43,057	1924	67,236	900,183
1902	2,830	20,655	1925	64,623	872,944
1903	1,361	20,515	1926	50,915	587,642
1904	2,850	9,298	1927	46,093	577,887
1905	3,933	16,221	1928	45,645	501,590
1906	4,032	40,320	1929	47,269	488,014
1907	6,405	57,720	1930	38,681	388,472
1908	10,582	80,822	1931	21,576	182,283
1909	7,942	62,588	Totals	1,285,503	$13,426,881

[1] See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

MARBLE

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXVI (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 106.

The 1931 production of marble in California was valued at $81,760 (including some onyx and travertine from Solano County and a small amount of limestone used as building stone and flagstone coming from an operator in Santa Barbara County). The marble came from a single quarry each in Amador and Tuolumne counties. The 1931 output showed a decrease in value from that of 1930 which was worth $82,194. During the last few years there has been a steadily increasing demand for flat stratified stones or flagstone to be used with both Spanish and English types of architecture.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amounts were preserved.

Total Production of Marble in California, by Years

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1910	18,960	$50,200
1888		5,000	1911	20,201	54,103
1889		87,030	1912	27,820	74,120
1890		80,000	1913	41,654	113,282
1891		100,000	1914	25,436	48,832
1892		115,000	1915	22,186	41,518
1893		40,000	1916	25,954	50,280
1894	38,441	98,326	1917	24,755	62,950
1895	14,864	56,566	1918	[a]17,428	49,898
1896	7,889	32,415	1919	25,020	74,482
1897	4,102	7,280	1920	[b]29,531	92,899
1898	8,050	23,594	1921	30,232	98,395
1899	9,682	10,550	1922	38,321	127,792
1900	4,103	5,891	1923	28,015	124,919
1901	2,945	4,630	1924	[b]31,579	140,253
1902	19,305	37,616	1925	35,664	116,105
1903	84,624	97,354	1926	34,806	119,999
1904	55,401	94,208	1927	[b]42,308	103,689
1905	73,303	129,450	1928	[b]34 324	82,190
1906	31,400	75,800	1929	[b]72,881	93,661
1907	37,512	118,066	1930	[b]65,775	82 194
1908	18,653	47,665	1931	[b]37,776	81,760
1909	79,600	238,400	Total value		$3,393,362

[a] Includes onyx and serpentine.
[b] Includes onyx and travertine.

ONYX and TRAVERTINE

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII, XVIII, XXI, XXIII. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1931 there were two producers of travertine in Solano County. The 1931 output showed a slight increase in both

quantity and value over that of 1930 the figures of which are combined with marble. This material is used in terrazzo, auto gear-shift handles, bases for fountain-pen desk sets, and other ornamental purposes.

Onyx Production of California, by Years.

Production by years has been as follows:

Year	Value	Year	Value
1887	*	1921	$1,294
1888	$900	1922	3,320
1889	900	1923	2,510
1890	900	1924	*
1891	1,500	1925	16,120
1892	2,400	1926	7,575
1893	1,800	1927	*
1894	27,000	1928	*
1895	20,000	1929	*
1896	12,000	1930	*
1918	24,000	1931	*
1919	*		
1920		Total value	$122,219

* See under Marble.

SANDSTONE

Bibliography: State Mineralogist Reports XII–XV, XVII, XVIII, XXI, XXIII, XXVI–XXVIII (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as

Carmel stone from quarries of Arthur H. Anthony, Carmel, Monterey County.

Photo by Arthur H. Anthony

well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1931 a total of 110,244 cu. ft. of sandstone, valued at $30,960, was quarried in California and came from properties in Los Angeles, Monterey, Napa, San Luis Obispo, and Tehama counties, by nine operators; compared with 160,704 cu. ft. valued at $56,404 in 1930.

Practically all of the material was flagstone which is used in garden walks, fountains, walls and fireplaces to give effect to Spanish and English types of homes. The material reported from Monterey and San Luis Obispo counties is in reality an indurated shale of the Monterey series, of a cream color and utilized as a building stone. Part of the material coming from Los Angeles County was schist and indurated shale.

A large portion of the sandstone was sold for landscape work and used as stepping stones for walks and for fountains, walls, etc.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$175,000	1910	165,971	$80,443
1888		150,000	1911	255,313	127,314
1889		175,598	1912	66,487	22,574
1890		100,000	1913	62,227	27,870
1891		100,000	1914	111,691	45,322
1892		50,000	1915	63,350	8,438
1893		26,314	1916	17,270	10,271
1894		113,592	1917	31,090	7,074
1895		35,373	1918	900	400
1896		28,379	1919	5,400	3,720
1897		24,086	1920	10,500	2,300
1898		46,384	1921	10,150	2,112
1899	56,264	103,384	1922	900	1,100
1900	378,468	254,140	1923	7,000	13,000
1901	266,741	192,132	1924	6,700	3,600
1902	212,123	142,506	1925	14,704	14,362
1903	353,002	585,309	1926	34,100	17,500
1904	363,487	567,181	1927	22,900	205.400
1905	302,813	483,268	1928	134.100	43 250
1906	182,076	164,068	1929	177,655	49,881
1907	159,573	148,148	1930	160,704	56,404
1908	93,301	55,151	1931	110,244	30,960
1909	79,240	37,032	Total value		$4,530,340

SERPENTINE

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California, by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Total Serpentine Production in California

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905		
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	[a]	[a]
1900	350	2,000	1918	[b]	[b]
1901	89	890	1919		
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[a] Under 'Unapportioned.'
[b] See under Marble.

SLATE

Bibliography: State Mineralogist Reports XV, XVIII, XXIV. Bulletin 38. U. S. Geol. Surv., Bull. 586. U. S. Bur. of Mines, Bull. 218.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

'Slate' is a term applied to a fine-grained rock that has a more or less perfect cleavage, permitting it to be readily split into thin, smooth sheets. Varieties differ widely in color and have a considerable range in chemical and mineralogical composition. Excepting certain rare slates of igneous origin (of which the green slate of the Eureka quarry, El Dorado County, California, is an example) formed from volcanic ash or igneous dikes, slates have originated from sedimentary deposits consisting largely of clay. By consolidation, and the pressure of superimposed materials, clays become bedded deposits of shale. By further consolidation under intense pressure and high temperature incident to mountain-building forces, shales are metamorphosed to slates. The principal mineral constituents are mica, quartz, and chlorite, with smaller varying amounts of hematite, rutile, kaolin, graphite, feldspar, tourmaline, calcite, and others.

The color of slate is of economic importance. The common colors are gray, bluish gray, and black, though reds and various shades of green are occasionally found.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.

"In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition." [1]

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

[1] Bowles, O., Slate as a Permanent Roofing Material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

The production of slate in California for 1929 and 1930 was 8220 tons valued at $71,347 f.o.b. rail-shipping point. The 1931 figures show a slight increase in amount with a decrease in value. The annual details are concealed under 'Unapportioned' owing to a single operator in both El Dorado and Tuolumne counties. Practically all of this slate was crushed and used for roofing granules.

Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1907	7,000	$60,000
1890	4,000	24,000	1908	6,000	60,000
1891	4,000	24,000	1909	6,961	45,660
1892	3,500	21,000	1910	1,000	8,000
1893	3,000	21,000	1911		
1894	1,800	11,700	1915	1,000	5,000
1895	1,350	9,450	1916		
1896	500	2,500	1920	8	80
1897	400	2,800	1921		
1898	400	2,800	1922	200	2,400
1899	810	5,900	1923		
1900	3,500	26,250	1926	[a]	7,371
1901	5,100	38,250	1927	[b]2,686	17,960
1902	4,000	30,000	1928	[b]4,075	31,263
1903	10,000	70,000	1929	*	
1904	6 000	50,000	1930	[b]3,220	71,347
1905	4,000	40,000	1931	*	*
1906	10,000	100,000			
			Total value		$806,820

* Annual details concealed under 'Unapportioned.'
[a] Quantity not shown as both 'squares' and 'tons' included.
[b] Tons.

MISCELLANEOUS STONE

Bibliography: State Mineralogist Reports XII–XXVII (inc.). Bulletin 38; also annual statistical bulletins from 1915 to date.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer; therefore it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. So far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put (or at least the proportions to each use) after they have quarried and sold the same to distributors and contractors.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept.

Both the output of sand and gravel, and crushed rock in California during 1931 showed a marked decrease in both amount and value from that of the previous year. This resulted in a total value of $11,848,531 for 'miscellaneous stone' during 1931, as compared with $16,430,027 in 1930.

As for several years past Los Angeles County led all counties by a wide margin in the annual output of these products, its 1931 yield being valued at $3,010,537 (compared with $4,731,302 in 1930); followed by Alameda second with $1,008,124; Marin third with $496,260; San Bernardino fourth with $496,246; Amador fifth with $491,465; followed in Imperial, San Diego, Santa Clara, Contra Costa, Butte, San Benito, Orange, Riverside, San Mateo, Sacramento, Sonoma counties in order named.

Paving Blocks.

During 1931 there was a small production of paving blocks in California coming from a property in San Diego County. The annual details are concealed under the 'Unapportioned' item to conceal the output of either operator.

The paving block industry has decreased materially of recent years, practically to the vanishing point, because of the increased construction of smoother pavements demanded by motor vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Madera, Placer, Riverside, San Bernardino, and San Diego are of granite; and those from San Mateo County a sandstone.

The amount and value of paving block production, annually, since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1910	4,434	$198,916
1888	10,500	367,500	1911	4,141	210,819
1889	7,303	297,236	1912	11,018	578,355
1890	7,000	245,000	1913	6,364	363,505
1891	5,000	150,000	1914	6,053	270,598
1892	*3,000	96,000	1915	3,285	171,092
1893	2,770	96,950	1916	1,322	54,362
1894	2,517	66,981	1917	938	38,567
1895	2,332	73,338	1918	372	17,000
1896	4,161	77,584	1919	27	1,350
1897	1,711	35,235	1920	63	3,155
1898	1,144	21,725	1921	4	280
1899	305	7,861	1922	72	3,924
1900	1,192	23,775	1923	15	880
1901	1,920	41,075	1924	11	935
1902	3,502	112,437	1925	27	1,350
1903	4,854	134,642	1926		
1904	3,977	161,752	1927	41	2,057
1905	3,408	134,347	1928	25	1,658
1906	4,203	173,432	1929		
1907	4,604	199,347	1930	66	5,900
1908	7,660	334,780	1931[a]		
1909	4,503	$199,803	Totals	135,838	$5,325,503

* Figures for 1887–1892 (inc.) are for Sonoma County only, as none are available for other counties during that period though Solano County quarries were then also quite active.

[a] Annual details concealed under 'Unapportioned.'

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, due to the war, there was a serious inquiry for domestic sources of supply. In 1916 and 1917 shipments totaled in excess of 20,000 tons per year; but they have since dropped to an insignificant figure. San Diego County has been the principal contributor, with some also from Fresno and Sacramento. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah. The material produced in recent years has been used in silex-lined mills for grinding clay, silica or feldspar, etc., where iron can not be present.

Imports to the United States in 1931 amounted to 5617 long tons, valued at $54,623, as compared with 6121 long tons, valued at $62,463 in 1930.

The 1931 output of grinding mill pebbles in California was concealed under 'Unapportioned' to conceal the production of a single operator in San Diego County.

The amount and value of grinding mill pebbles, annually, follows:

Year	*Tons*	*Value*
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,268
1919	2,607	19,272
1920	2,104	17,988
1921	247	1,418
1922	1,571	7,628
1923	2,650	14,936
1924	434	2,969
1925	215	1,385
1926	102	612
1927	288	1,800
1928	372	2,408
1929 } 1930 } *	166	1,225
1931	*	*
Totals	61,406	$263,824

* Annual details concealed under 'Unapportioned.'

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

The distribution of the 1931 output of sand and gravel, by counties is given in the following table:

County	Tons	Value	County	Tons	Value
Alameda	[a] 1,356,852	$872,274	San Benito	48,500	$21,400
Amador	5,000	3,875	San Bernardino	242,753	127,889
Butte	400,862	281,226	San Diego	[a] 316,718	358,424
Colusa	249,000	88,225	San Joaquin	178,059	87,673
Contra Costa	[ab] 174,925	84,574	San Luis Obispo	[a] 89.803	57,616
Del Norte	16,614	20,540	San Mateo	[a] 16,887	11,744
Fresno	129,416	93,679	Santa Barbara	102,888	58,926
Humboldt	140,275	100,352	Santa Clara	288,615	184,649
Imperial	151,232	70,959	Santa Cruz	87,244	63,824
Kern	91,760	63,682	Shasta	7,539	7,138
Lake	39,055	11,335	Sierra	26,250	30,750
Los Angeles	[bc] 2,109,461	1,190,364	Siskiyou	12,438	13,094
Madera	3,631	1,815	Sonoma	221,452	79,882
Mariposa	1,050	1,050	Stanislaus	134,790	85,761
Mendocino	42,810	25,493	Tehama	38,241	49,407
Merced	57,250	28,500	Trinity	17,730	19,228
Modoc	180,114	30,185	Tu'are	24,170	13,880
Monterey	[ab] 119,966	50,148	Ventura	[a] 269,938	155,680
Napa	27,240	21,427	Calaveras, Glenn,		
Nevada	4,050	9,234	Inyo, Marin,		
Orange	208,999	109,972	Mono, Solano,		
Placer	8,195	3,140	Yolo, Yuba*	143,632	97,253
Plumas	13,500	8,500			
Riverside	[a] 154,928	99.867	Totals	8,162,753	$4,922,853
Sacramento	[a] 208,921	128,189			

* Combined to conceal output of a single operator in each.
[a] Includes molding sand.
[b] Includes blast sand.
[c] Includes sand for roofing granules.

Included in the above is a total of 27,651 tons of molding sand valued at $64,830, coming from three properties in San Diego County; two properties each in Contra Costa, Monterey and Riverside counties, and one each in Alameda, Sacramento, San Luis Obispo, San Mateo, and Ventura counties. This item is each year assuming a more important position in the commercial mineral list in California. The 1930 figures were 49,617 tons worth $110,960.

Crushed Rock.

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis of like operations.

The values given are based on the selling price, f.o.b. cars, barges, or trucks, at the quarry.

Crushed Rock Production, by Counties, for 1931

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassified		Total	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	52,932	$16,655			55,597	$58,237	[b]53,767	$60,958	162,296	$135,850
Amador	30,025	25,590			154,000	462,000			184,025	487,590
Butte	7,734	6,925					*	*	7,734	6,925
Calaveras	20,379	22,170	*	*			*	*	20,379	22,170
Del Norte	8,832	16,162							8,832	16,162
El Dorado	38,400	20,089					*	*	38,400	20,089
Fresno	97,101	61,127			*	*			97,101	61,127
Humboldt	76,116	93,972							76,116	93,972
Imperial	176,774	309,667	13,208	$8,411	*	*	*	*	189,982	318,078
Los Angeles	261,935	152,351	78,163	133,713	1,956,901	1,386,350	[d]356,846	147,759	2,653,845	1,820,173
Madera	[d]400	200							400	200
Mariposa	137	360	10,725	25,000			*	*	10,862	25,360
Mendocino	16,110	45,262							16,110	45,262
Modoc	85,994	146,673					7,491	3,246	93,485	149,919
Mono	47,308	48,079							47,308	48,079
Nevada	71,280	113,790							71,280	113,790
Orange	137,040	57,995			*	*			137,040	57,995
Placer	33,150	51,382	1,260	1,144					34,410	52,526
Plumas			22,075	6,350	5,400	5,400			27,475	11,750
Riverside	50,173	48,756	*	*					50,173	48,756
Sacramento	9,573	4,789	159	80	*	*	*	*	9,732	4,869
San Bernardino	243,489	198,597	*	*			[b]182,822	130,332	426,311	328,929
San Mateo	182,541	174,154	*	*	*	*	13,000	14,375	195,541	188,529
San Luis Obispo	132,000	92,400							132,000	92,400
Santa Barbara	12,300	8,550							12,300	8,550
Santa Clara	222,940	131,910	*	*	*	*	94,087	73,636	317,027	205,546
Santa Cruz	36,739	33,928	*	*	*	*			36,739	33,928
Shasta	100,324	145,887					*	*	100,324	145,887
Sierra	11,106	7,000							11,106	7,000
Siskiyou	57,007	61,278			*	*			57,007	61,278
Sonoma	60,198	72,759	*	*	*	*			60,198	72,759
Trinity			44	1,018					44	1,018
Tulare	11,193	52,788	621	4,760	2,075	3,550	[d]961	800	14,850	61,898
Tuolumne	139,707	95,000					*	*	139,707	95,000

Contra Costa, Inyo, Kern, Monterey, Napa, San Benito[d], San Diego[d], San Francisco, San Joaquin, Ventura, and Yuba*	800,274	465,675							800,274	465,745
Calaveras, Marin, Riverside, San Benito, San Bernardino, San Diego, San Mateo, Santa Clara, Santa Cruz and Sonoma*			497,692	634,989					497,692	634,989
Contra Costa, Fresno, Imperial, Kern, Marin, Monterey, Orange, Sacramento, San Diego, San Francisco, San Mateo, Santa Clara, Santa Cruz, Siskiyou, and Sonoma*					544,158	487,304			544,158	487,304
Butte[a], Calaveras[b], El Dorado, Imperial, Inyo, Lake, Marin, Mariposa[b], Monterey, Napa, Sacramento[d], San Benito, San Diego[d], San Joaquin, Shasta, Solano, Stanislaus, Tuolumne[a], and Ventura*							502,297	494,346	502,297	494,346
Totals	3,131,211	$2,781,920	623,947	$815,465	2,718,131	$2,402,841	1,211,271	$925,452	7,685,560	$6,925,678

* Combined to conceal the output of a single operator.
[a] Includes granules for terrazzo.
[b] Includes granules for roofing.
[d] Includes decomposed granite.

Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1913	9,817,616	$4,823,056
1894	661,900	664,838	1914	9,288,397	3,960,973
1895	1,254,688	1,095,939	1915	10,879,497	4,609,278
1896	960,619	839,884	1916	9,951,089	4,009,590
1897	821,123	600,112	1917	8,069,271	3,505,662
1898	1,177,365	814,477	1918	6,641,144	3,325,889
1899	964,898	786,892	1919	6,919,188	3,678,322
1900	789,287	561,642	1920	9,792,122	6,782,414
1901	530,396	641,037	1921	10,914,145	7,834,540
1902	2,056,015	1,249,529	1922	13,049,644	10,366,231
1903	2,215,625	1,673,591	1923	19,840,301	15,379,338
1904	2,296,898	1,641,877	1924	21,451,129	15,962,476
1905	2,624,257	1,716,770	1925	23,819,137	17,407,113
1906	1,555,372	1,418,406	1926	24,987,606	19,859,261
1907	2,288,888	1,915,015	1927	25,126,691	18,912,994
1908	3,998,945	3,241,774	1928	27,471,794	17,328,044
1909	5,531,561	2,708,326	1929	27,104,618	17,840,159
1910	5,827,828	2,777,690	1930	23,514,168	16,430,027
1911	6,487,223	3,610,357	1931	15,848,313	11,848,531
1912	8,044,937	4,532,598			
			Totals	334,944,795	$236,811,327

A comparison of the above table of annual production of these materials with the similar table for cement (see *ante*) reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902.

CHAPTER FIVE

INDUSTRIAL MATERIALS

Bibliography: State Mineralogist Reports XII-XXVII (inc.). Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly-defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material.

The more important of these minerals thus far exploited, so far as shown by value of the output, are barytes, bentonite (fuller's earth), pottery clay, diatomite, dolomite, gypsum, limestone, mineral water, pumice and volcanic ash, pyrite, silica, and soapstone and talc.

This group as a whole showed a decrease in the total value from $7,168,522 in 1930 to $4,741,939 in 1931.

The following table gives the comparative figures for the amounts and value of industrial minerals produced in California during the years 1930 and 1931:

Substance	1930		1931		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Barytes	19,783 tons	$133,107	27,682 tons	$156,647	$23,540+
Bentonite (fuller's earth)	12,522 tons	177,964	13,960 tons	222,583	44,619+
Clay (pottery)	938,536 tons	795,517	332,680 tons	408,931	386,586—
Dolomite	35,721 tons	106,813	*	*	*
Feldspar	5,014 tons	35,654	4,795 tons	59,921	24,267+
Gems		3,540		5,607	2,067+
Gypsum	116,865 tons	243,507	88,354 tons	199,198	44,309—
Limestone	169,477 tons	508,751	177,268 tons	560,699	51,948+
Mineral water	37,354,111 gals.	2,870,663	26,164,331 gals.	1,347,860	1,522,803—
Pumice and volcanic ash	12,947 tons	128,847	11,711 tons	108,130	20,717—
Pyrite	39,954 tons	194,228	25,402 tons	131,174	63,054—
Silica (sand and quartz)	17,802 tons	71,380	43,330 tons	182,769	111,389+
Soapstone and talc	15,861 tons	154,258	13,472 tons	109,940	44,318—
Unapportioned		[a]1,744,293		[b]1,248,480	495,813—
Total values		$7,168,522		$4,741,939	
Net decrease					$2,426,583

* 'Unapportioned.'

[a] Includes asbestos, diatomite, mineral paint, sillimanite-andalusite-cyanite group and sulphur.

[b] Includes dolomite, diatomite, mineral paint, mica, sillimanite-andalusite-cyanite group and sulphur.

ASBESTOS

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXII, XXVII (inc.) Bulletins 38, 91. Canadian Dept. of M., Mines Branch Bulletin 69. Min. and Sci. Press, April 10, 1920, pp. 531–533. Eng. & Min. Jour.-Press, Vol. 113, pp. 617–625, 670–677. Asbestology, Vol. 5, No. 7, July, 1927.

During 1931 there was no production of asbestos reported in California. In 1930 there was a small tonnage of short fiber chrysotile asbestos ore mined in Monterey County, from which fiber was produced, also shipment of amphibole asbestos from two properties in Riverside County, both of which were operated by the same party. The figures are concealed under the 'Unapportioned' item to conceal the output of either operator. The 1929 output was the amphibole variety and came from Shasta County.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Calaveras, and Monterey counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

For many years Canada has led in the production of asbestos and now produces about 65 per cent of world's output, followed by Rhodesia and Soviet Russia.

Asbestos Production of California, by Years.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	1,800	1910	200	$20,000
1888	30	1,800	1911	125	500
1889	30	1,800	1912	90	2,700
1890	71	4,260	1913	47	1,175
1891	66	3,960	1914	51	1,530
1892	30	1,830	1915	143	2,860
1893	50	2,500	1916	145	2,380
1894	50	2,250	1917	136	10,225
1895	25	1,000	1918	229	9,903
1896			1919	131	6,240
1897			1920		
1898	10	200	1921	410	19,275
1899	30	750	1922	50	1,800
1900	50	1,250	1923	20	200
1901	110	4,400	1924	70	4,750
1902			1925		
1903			1926	25	1,650
1904	10	162	1927		
1905	112	2,625	1928	13	1,160
1906	70	3,500	1929		
1907	70	3,500	1930	219	6,175
1908	70	6,100	1931		
1909	65	6,500			
			Totals	3,083	$142,710

*Annual details concealed under 'Unapportioned.'

BARYTES

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XXI, XXVII, (inc.). Bulletins 38, 87. Eng. & Min. Jour.-Press, Vol. 114, p. 109, July 15, 1922; Vol. 115, pp. 319–324, Feb. 17, 1923. U. S. Bureau of Mines, Inform. Circ. 6221, 6223.

During 1931 there was a commercial production of crude barytes in California amounting to a total of 27,832 short tons valued at $156,647 f.o.b. rail shipping point. This was an increase in both quantity and value over the 1930 output, which was 19,783 tons worth $133,107. The 1931 yield came from a single property each in Inyo, Mariposa, Santa Barbara, Shasta, and Tulare counties. This material was consumed in the manufacture of lithopone, in heavy gravity oil-well drilling mud and barium chemicals. The mining of barytes has been showing a steady increase with 1931 showing the largest annual production.

More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared white pigment containing approximately 70% barium sulphate and 30% zinc sulphide. This is one of the principal constituents of 'flat' wall paints. Other important uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleums, oilcloth and rubber manufacture, and in the preparation of a number of chemicals including barium binoxide, carbonate, chloride, nitrate, and the sulphate precipitated, or 'blanc fixe.'

The Tariff Act of 1930 placed a duty on foreign imported barytes ore, crude or unmanufactured, of $4 per ton; ground or otherwise manufactured, of $7.50 per ton.

Present quotations for barytes (93% $BaSO_4$) vary from $6 to $7 (Calif. $7) per ton, crude, f.o.b. rail-shipping point. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposits at El Portal, in Mariposa County, have given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Total Barytes Production of California.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1922	3,370	$18,925
1911	309	2,207	1923	2,925	16,058
1912	564	2,812	1924		
1913	1,600	3,680	1925		
1914	2,000	3,000	1926	4,978	38,165
1915	410	620	1927	17,993	90,617
1916	1,606	5,516	1928	13,406	55,888
1917	4,420	25,633	1929	26,796	168,829
1918	100	1,500	1930	19,783	133,107
1919	1,501	18,065	1931	27,832	156,647
1920	3,029	20,795			
1921	901	4,809	Totals	134,383	$772,513

BENTONITE (FULLER'S EARTH)

Bibliography: State Mineralogist Reports XIV, XVII, XVIII, XXI, XXIII, XXV–XXVI (inc.) Bulletins 38, 91. U. S. Bureau of Mines, Bulletin 71. Eng. & Min. Jour.-Press, Vol. 121, pp. 837–842, May 22, 1926.

During 1931 there was produced in California 13,960 short tons of bentonite (fuller's earth) valued at $222,583 coming from eight properties in San Bernardino County, two properties in each, Kern and San Diego counties, and a single property in each Inyo, Los Angeles, and San Benito counties. Previous to 1931 the Division of Mines classed this material under the heading of "fuller's earth," but it was thought advisable to change the name to bentonite, owing to the fact that much bentonite is employed in uses that can not be classed as fuller's earth and therefore has been classified in these reports under pottery clay. This made a confusion in classification. The 1930 output was 12,522 tons worth $177,964.

Bentonite is a name applied to the clays of the montmorillonite and halloysite group ('rock soap'). These clays have the property, when wetted with water, of expanding many times their original volume. The wetted material is smooth and feels like soap. As fuller's earth some bentonites have the physical property, when treated with dilute sulphuric acid, of absorbing basic colors and removing these colors from solution as well as other impurities in animal, vegetable and mineral oils. It is also utilized to emulsify asphalt to be used in cold-laid pavements; in medical dressings; as a filler in paper, cloth, leather, linoleum, etc.; as an adulterant in candies, paints, drugs, etc.; in cosmetics and beauty muds; as decolorizing and deodorizing clay; as a sealing agent in irrigating ditches and earth reservoirs; as a conditioner in oil-well drilling mud; as a de-inking agent of paper; as an ingredient in soap; as a water-softening agent and water proofer for concrete, and as a retarder in gypsum plasters.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo and Kern counties.

Clays of the montmorillonite and halloysite group ('rock soap') are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

The Tariff Act of June 21, 1930, placed a duty of $1.50 a ton on foreign produced imported fuller's earth.

Bentonite Production of California by Years.

Bentonite including a small amount of fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time is as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1916	110	$550
1900	500	3,750	1917	220	2,180
1901	1,000	19,500	1918	37	333
1902	987	19,246	1919	385	3,810
1903	250	4,750	1920	600	6,000
1904	500	9,500	1921	1,185	8,295
1905	1,344	38,000	1922	6,606	48,756
1906	440	10,500	1923	3,650	55,125
1907	100	1,000	1924	5,290	67,295
1908	50	1,000	1925	5,280	91,842
1909	459	7,385	1926	23 552	250,192
1910	340	3,820	1927	13,018	154,764
1911	466	5,294	1928	53 323	501,743
1912	876	6,500	1929	15,541	170,563
1913	460	3,700	1930	12,522	177,964
1914	760	5,928	1931	13,960	222,583
1915	692	4,002			
			Totals	147,131	$1,254,181

CLAY (Pottery)

Bibliography: State Mineralogist Reports I, IV, IX, XII–XV, XVIII–XXVII (inc.). Bulletins 38, 99. Preliminary Report No. 7. U. S. Bureau of Standards, Tech. Paper No. 262.

At one time or another in the history of the state, pottery clay has been mined in thirty-three of its counties. Of these, 17 contributed in 1930. In this report, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flower pots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and hollow building blocks.

There are many other important uses for clay besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly-finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps and for filtering oils and as oil-well drilling mud, also as an earth filler in irrigating ditches which run through porous ground.

During 1931 there was a total of 59 properties in 17 counties which reported an output of 332,680 short tons of pottery clay having a total value of $408,931 f.o.b. rail-shipping point for the crude material, as compared with 72 properties in 20 counties, producing 938,586 tons

worth $795,517 in 1930. The decrease in the output of crude clay is accounted for by the decline in the manufacture of clay products.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1931 is shown herewith:

Pottery Clay in 1931

County	Tons	Value	Used in the manufacture of
Alameda	5,505	$3,048	Architectural terra cotta; chimney, drain and sewer pipe; faience, floor, decorative and roofing tile; garden furniture, refractories and various.
Amador	32,275	57,751	Architectural terra cotta; fire-clay products and refractories; chimney, drain and sewer pipe; floor, mantel and roofing tile; electrical porcelain and various.
Contra Costa	5,368	3,813	Roofing, floor and mantel tile, sagger, drain and sewer pipe, and various.
Kern	[a]27,499	46,668	Oil well drilling mud, refractories, sanitary ware, electrical porcelain, stone ware and various.
Los Angeles	27,971	25,359	Architectural terra cotta; conduit and segment blocks, electrical porcelain, red earthen ware, refractories, chimney, drain and sewer pipe, vents, floor, mantel and roofing tile, art pottery and various.
Orange	21,900	28,430	Stone ware, refractories, vents, drain, floor and mantel tile and various.
Placer	78,501	122,515	Architectural terra cotta; chimney, drain and sewer pipe; faience, floor, mantel and roofing tile; red earthen ware, electrical porcelain, sanitary ware, and various.
Riverside	56,341	79,968	Conduit, sewer and drain pipe; red earthen ware, faience, floor, mantel and roofing tile and various.
San Bernardino	1,220	5,333	Floor and roofing tile; stone ware, sanitary ware, art pottery, refractories and various.
San Diego	11,421	15,478	Sewer and drain pipe; faience, floor, mantel and roofing tile. Refractories, sanitary ware and various.
Santa Clara	2,665	1,826	Sewer pipe, art pottery, drain, floor, mantel and roofing tile, stone ware and various.
Ventura	[a]61,300	17,418	Oil well drilling mud, drain floor tile.
Humboldt, Monterey, Sacramento, Santa Barbara and Stanislaus*	714	1,324	Drain, roofing and mantel tile; saggers, electrical porcelain, refractories and various.
Totals	332,680	$408,931	

* Combined to conceal the output of a single operator in each.
[a] Includes clay and shale for oil well drilling mud.

POTTERY CLAY PRODUCTS

The values of the various pottery clay products made in California during 1931 totaled $8,742,331 as compared with $12,014,535 in 1930, their distribution being shown in the following tabulation:

Product	*Number of producers*	*Tons*	*Value*
Architectural terra cotta	5	10,829	$1,103,407
Chimney pipe and flue lining	9	4,371	149,256
Drain pipe	17	5,742	71,414
Sewer pipe	8	43,578	1,047,295
Roofing tile	28	65,730	1,063,849
Electrical porcelain	5	-----	383,829
Red earthenware	10	-----	201,437
Stoneware and chemical stoneware	7	-----	372,218
Chinaware and semivitreous tableware	4	-----	408,991
Sanitary ware and plumbing	6	-----	1,481,400
Floor, faience, mantel and handmade tile	35	-----	2,023,543
Ground fire clay and high temperature cement	6	3,008	37,821
Refractories: gas-stove backs, clay-shapes, tank backs, segment blocks, etc.	7	-----	113,409
Miscellaneous: art tile and pottery, chimney tops, garden furniture, specialties, rock wool, electrical conduits, molding clay, grog, etc.	18	-----	284,462
Total value			$8,742,331

Important increases were shown by architectural terra cotta, red earthenware, stoneware and chemical stoneware. All other groups showed a decrease in value from 1931 totals.

California tile, at Agua Caliente, Lower California, Mexico.

Photo by Walter W. Bradley

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1910	249,028	$324,099
1888	75,000	37,500	1911	224,576	252,759
1889	75,000	37,500	1912	199,605	215,683
1890	100,000	50,000	1913	231,179	261,273
1891	100,000	50,000	1914	179,948	167,552
1892	100,000	50,000	1915	157,866	133,724
1893	24,856	67,284	1916	134,636	146,538
1894	28,475	35,073	1917	166,298	154,602
1895	37,660	39,685	1918	112,423	166,788
1896	41,907	62,900	1919	135,708	245,019
1897	24,592	30,290	1920	203,997	440,689
1898	28,947	33,747	1921	225,120	362,172
1899	40,600	42,700	1922	277,232	473,184
1900	59,636	60,956	1923	376,863	697,841
1901	55,679	39,144	1924	417,928	651,857
1902	67,933	74,163	1925	537,587	674,376
1903	90,972	99,907	1926	801,461	806,509
1904	84,149	81,952	1927	867,419	872,661
1905	133,805	130,146	1928	887,807	1,394,950
1906	167,267	162,283	1929	839,949	1,127,527
1907	160,385	254,454	1930	938,586	795 517
1908	208,042	325,147	1931	332,680	408,931
1909	299,424	465,647	Totals	10,577,225	$13,042,229

DIATOMITE (DIATOMACEOUS EARTH)

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXVII (inc.). Bulletins 38, 67, 91. Am. Inst. Min. Eng. Bull., 104, August, 1915, pp. 1539–1550. U. S. Bur. of Mines, Rep. of Investigations: Serial No. 2431, Jan., 1923. Eng. & Min. Jour.-Press, Vol. 115, pp. 1152–1154, June 30, 1923.

Diatomite, also known as diatomaceous earth, infusorial earth, tripolite and kieselguhr, is very light (when dry a cubic foot weighs 18 to 20 pounds) and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of diatomaceous earth (also called 'diatomite') is as a cement admixture. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration, also sound-proofing. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' is was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes and safes, and in fireproof cement. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. A mixture of it with asphalt is used in the manufacture of so-called "hard rubber" such as used in storage battery boxes, etc. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as

in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier maché, and for solidifying bromine. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

As about 85 per cent of the California output is from a single operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were six operators during 1931 in Fresno, Los Angeles, Monterey, and Santa Barbara counties. The shipments during the year showed a slight decrease in total tonnage and value compared with 1929.

The material shipped was utilized for insulation of both heat and sound, filtration, paint, pigment, cement admixture, fillers, abrasives and for clarification of gasoline and kerosene.

Total Production of Diatomite in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1911	2,194	$19,670
1890			1912	4,129	17,074
1891			1913	8,645	35 968
1892			1914	12,840	80,350
1893	50	2,000	1915	12,400	62,000
1894	51	2,040	1916	15,322	80,649
1895			1917	24,301	127,510
1896			1918	35,963	189,459
1897	5	200	1919	40,200	217,800
1898			1920	60,764	1,056,260
1899			1921	*90,739	1,016,675
1900			1922		
1901			1923		
1902	422	2,532	1924	*193,064	5,729,736
1903	2,703	16,015	1925		
1904	6,950	112,282	1926		
1905	3,000	15,000	1927	* 275,403	1,995,923
1906	2,430	14,400	1928		
1907	2,531	28,948	1929		
1908	2,950	32,012	1930	*300,017	4,848,661
1909	500	3,500	1931		
1910	1,843	17,617	Totals	1,099,455	$15,723,616

* Annual details concealed under 'Unapportioned.'

DOLOMITE

Bibliography: State Mineralogist Reports XV, XVII, XXVII

The 1930 production of dolomite in California came from a single quarry each in Inyo and Monterey counties. The annual details are concealed under the 'Unapportioned' item to conceal the output of

either operator, and showed a decrease in both quantity and value from the 1930 and 1931 output which was 66,564 short tons worth $161,245. The material shipped was utilized for steel furnace flux and refractories, plaster, stucco dash-coat, and for manufacture of CO_2.

Dolomite Production of California, by Years.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included under limestone, as the two minerals are closely related chemically; but since dolomite, as such, has been found to have certain distinctive applications, we here give it a separate classification.

Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
1922	52,409	114,911
1923	69,519	142,615
1924	28,843	71,271
1925	42,852	104,900
1926	68,610	119,313
1927	45,976	79,442
1928	38,379	85,342
1929	58,644	156,928
1930	66,564	161,245
1931		
Totals	639,887	$1,542,793

* Annual details concealed under 'Unapportioned.'

FELDSPAR

Bibliography: State Mineralogist Reports XV, XVII-XXVII (inc.). Bulletins 67, 91. U. S. Bureau of Mines, Bulletin 92. Eng. & Min. Jour.-Press, Vol. 115, pp. 535-538, Mar. 24, 1923.

Feldspar was produced by six operators in three counties (Kern, Riverside, and San Diego) in California during 1931 to the amount of 4795 short tons valued at $59,921. This was a decrease in quantity with an increased value over the 1930 figures, which were 5014 tons and $35,654.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20 per cent, and in some cases the potters specify less than 5 per cent. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

Total Feldspar Production of California.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

Total Feldspar Production in California

Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1922	4,587	$37,109
1911	740	4,560	1923	11,100	81,800
1912	1,382	6,180	1924	9,055	68,112
1913	2,129	7,850	1925	8,165	59,615
1914	3,530	16,565	1926	7,300	56,400
1915	1,800	9,000	1927	10,932	86,101
1916	2,630	14,350	1928	14,628	93 745
1917	11,792	46,411	1929	13,327	78,404
1918	4,132	22,061	1930	5,014	35,654
1919	1,272	12,965	1931	4,795	59,921
1920	4,518	26,189			
1921	4,349	28,343	Totals	128,937	$857,050

FLUORSPAR

Bibliography: State Mineralogist Reports XVII, XVIII, XXIV, XXVI. Bulletins 67, 91. Eng. & Min. Jour.-Press, Vol. 177, pp. 489–492, Mar. 22, 1924.

Fluorspar, or calcium fluoride, CaF_2, is one of the most important nonmetallic minerals from an industrial standpoint. About 80 per cent of the commercial mineral is prepared in the 'gravel' form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found. In the United States, under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacture of enameled ware, glazed tile and brick, opalescent glass and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms: lump, gravel, and ground.

According to the U. S. Bureau of Foreign and Domestic Commerce, imports of fluorspar into the United States in 1930 amounted to 57,949 long tons, valued at $544,656, and came principally from England, with smaller amounts from British South Africa, Italy, China and Netherlands. The 1930 figures were an increase from the previous year when 48,522 short tons worth $480,975 were imported.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but no commercial production has resulted except in 1917–1918, when a total of 79 tons valued at $991 was shipped from Riverside County.

The Tariff Act of June 21, 1930, places a duty of $5.60 per ton on foreign importations of fluorspar.

Present quotations (Metal and Mineral Markets) are: not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $12 per ton; foundry lamp $14 per ton.

GEMS

Bibliography: State Mineralogist Reports II, XIV, XV, XVII, XVIII, XX, XXI–XXVII (inc.). Bulletins 37, 67, 91. U. S. G. S., 'Mineral Resources of the U. S.'; Bull. 603, p. 208. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149–153, 331–380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to widely-scattered places at which stones are gathered and marketed for the most part in a small way. The gem material reported in California during 1931 had a total value of $5,607 in the rough. The 1931 output came from Butte, Calaveras, Fresno, Riverside, San Benito, San Bernardino, San Diego, and Tulare counties and consisted of diamonds, quartz crystals, topaz, Iceland spar, benitoite, blue-agate, myrickite, jasper, bloodstone, agate, amethyst, emeralite, indicolite, beryl, tourmaline, chrysoprase, and rose quartz. The above showed an increased value over the 1930 output, which was worth $3,540. One of the diamonds found during the year weighed 2 carats 27 points.

Varieties of California's Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green, also blue.

One of our California gem stones, *benitoite,* has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of *vesuvianite,* and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Garnets are found in a number of localities in California; the important yield of gems being *hyacinth* and *spessartite* varieties from San Diego County.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Sapphires have been reported found in San Bernardino and Riverside counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occurring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

Year	Value	Year	Value
1900	$20,500	1917	$3,049
1901	40,000	1918	650
1902	162,100	1919	5,425
1903	110,500	1920	36,056
1904	136,000	1921	10,954
1905	148,500	1922	1,312
1906	497,090	1923	13,220
1907	232,642	1924	4,800
1908	208,950	1925	10,663
1909	193,700	1926	9,019
1910	237,475	1927	7,035
1911	51,824	1928	22,200
1912	23,050	1929	26,850
1913	13,740	1930	3,540
1914	3,970	1931	5,607
1915	3,565		
1916	4,752	Total	$2,248,768

GRAPHITE

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII, XXVI (inc.). Bulletins 67, 91. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite (also called plumbago) has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and No. 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price.

The principal value of graphite is on account of its infusibility and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material, the best quality crystalline variety being quoted at present (f.o.b. New York) at 6½–7½¢ per pound (Ceylon lumps).

The coarser flakes are necessary for crucibles, as they help to bind the clay together, in addition to their refractory service. Imports in 1931 from Ceylon, Canada, Madagascar, Mexico and Korea totaled 9090 short tons, valued at $259,759, compared with 16,726 tons valued at $624,668 in 1930.

The Tariff Act of June 21, 1930, placed a duty on graphite or plumbago, crude or refined; Amorphous, 10% ad valorem; crystalline lump, chip or dust, 30% ad valorem; crystalline flake 1 65/100 cents per lb.

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties. There was no production, however, in 1928–1931 (inc.).

Graphite Production of California, by Years.

According to the records of the State Mining Bureau, the graphite production of California, by years, has been as follows:

Year	*Pounds*	*Value*
1901	128,000	$4,480
1902	84,000	1,680
1903		
1913	2,500	25
1914		
1915		
1916	29,190	2,335
1917		
1918	*770,000	37,225
1919		
1920		
1921		
1922	*624,000	26,160
1923		
1925		
1926	*76,000	13,120
1927		
1928		
Totals	2,113,690	$85,025

* Annual details concealed under 'Unapportioned,' on account of a single producer.

GYPSUM

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XXII, XXIII, XXV–XXVII (inc.). Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 223, 413, 430, 697. U. S. Bur. of Standards, Circular No. 281.

During the year 1931 there were shipments of gypsum in California amounting to 88,354 short tons valued at $199,198, coming from two properties in Riverside County and a single property each in Fresno, Imperial and Kern counties. This was a decrease in both quantity and value from the 1930 output, which was 116,865 tons worth $243,507.

Uses.

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2%, by weight, raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application, the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Keene's cement is a gypsum product, calcined to complete dehydration, and an accelerator added such as alum, potassium sulphate, borax, aluminum sulphate.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1910	45,294	$129,152
1888	2,500	25,000	1911	31,457	101,475
1889	3,000	30,000	1912	37,529	117,388
1890	3,000	30,000	1913	47,100	135,050
1891	2,000	20,000	1914	29,734	78,375
1892	2,000	20,000	1915	20,200	48,953
1893	1,620	14,280	1916	33,384	59,533
1894	2,446	24,584	1917	30,825	56,840
1895	5,158	51,014	1918	19,695	37,176
1896	1,310	12,580	1919	19,813	50,579
1897	2,200	19,250	1920	20,507	92,535
1898	3,100	23,600	1921	37,412	78,875
1899	3,663	14,950	1922	47,084	188,336
1900	2,522	10,088	1923	86,410	289,136
1901	3,875	38,750	1924	25,569	53,210
1902	10,200	53,500	1925	107,613	172,444
1903	6,914	46,441	1926	114,868	211,337
1904	8,350	56,592	1927	94,630	292,090
1905	12,859	54,500	1928	104,790	200,567
1906	21,000	69,000	1929	140,844	396,951
1907	8,900	57,700	1930	116,865	243,507
1908	34,600	155,400	1931	88,354	199,198
1909	30,700	138,176	Totals	1,474,585	$4,225,112

LIMESTONE

Bibliography: State Mineralogist Reports IV, XII–XV (inc.), XVII–XXVII (inc.). Bulletins 38, 91. Oregon Agr. College Extension Bulletin 305. Eng. and Min. Jour.-Press, Vol. 120, pp. 249–253.

'Industrial' limestone was produced by 19 operators in 11 counties in California during 1931 to the amount of 177,268 short tons valued at $560,699 coming from three quarries each in El Dorado, San Bernardino and Santa Cruz counties, and two each in San Mateo, Santa Clara and Tulare counties, and one each in Alameda, Fresno, Inyo, Mendocino, San Benito, Tuolumne, and Ventura counties. The above showed an increase in amount and value over the 1930 output, which was 169,477 tons worth $508,751.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. The material from Fresno and Ventura counties and one operator in San Bernardino county was marl; and that from Alameda, San Mateo and Santa Clara counties was shells, dredged from San Francisco Bay, all of which was ground and used for agricultural purposes and poultry grit. Of the total 'Industrial' limestone produced in 1931, approximately 45,109 short tons worth $217,392 were used for agricultural purposes and poultry grit.

Distribution of the 1931 output of limestone was as follows:

County	*Tons*	*Value*
El Dorado	79,798	$207,594
Santa Cruz	9,383	34,430
Alameda,[b] Fresno,[a] Mendocino, San Benito, San Bernardino,[a] San Mateo,[b] Santa Clara,[b] Tulare, Tuolumne, and Ventura[a]	88,087	318,675
Totals	177,268	$560,699

* Combined to conceal the output of operators in each.
[a] Includes marl.
[b] Includes shells.

Limestone Production of California, by Years.

The following tabulation gives the amounts and value of 'industrial' limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included:

Limestone Production of California, by Years

Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1914	572,272	$517,713
1895	71,355	71,690	1915	146,324	156,288
1896	68,184	71,112	1916	187,521	217,733
1897	36,796	38,556	1917	237,279	356,396
1898	27,686	24,548	1918	208,566	456,258
1899	30,769	29,185	1919	88,291	248,145
1900	32,791	31,532	1920	90,120	298,197
1901	76,937	99,445	1921	75,921	305,912
1902	71,422	90,524	1922	84,382	282,181
1903	125,919	163,988	1923	143,266	348,464
1904	40,207	87,207	1924	219,476	582,660
1905	192,749	323,325	1925	319,977	494,525
1906	80,262	162,827	1926	108,795	367,501
1907	230,985	406,041	1927	699 790	663,957
1908	273,890	297,264	1928	127.895	397 935
1909	337,676	419,921	1929	168,315	557,617
1910	684,635	581,208	1930	169,477	508.751
1911	516,398	452,790	1931	177,268	560,699
1912	613,375	570,248			
1913	301,918	274,455	Totals	7,653,309	$11,5-5,073

LITHIA

Bibliography: State Mineralogist Reports II, IV, XIV, XXI. Bulletins 38, 67, 91.

Lithia mica, lepidolite (a silicate of lithium and others) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915, though there was none shipped in 1923, 1925, 1929, 1931 (inc.). During 1930 there was a small amount of lepidolite mined in California, but none shipped. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines.

Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1920	10,046	$153,502
1900	440	11,000	1921	*1,365	20,781
1901	1,100	27,500	1922		
1902	822	31,880	1923		
1903	700	27,300	1924	109	2,269
1904	641	25,000	1925		
1905	25	276	1926		
1906			1927	*550	13,900
1915	91	1,365	1928		
1916	71	1,065	1929		
1917	880	8,800			
1918	4,111	73,998	Totals	21,875	$417,636
1919	800	14,400			

* Annual details concealed under 'Unapportioned.'

MICA

Bibliography: State Mineralogist Reports II, IV, XXVI, XXVII. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 740; Min. Res. of U. S. Eng. & Min. Jour.-Press, Vol. 115, pp. 55–60, Jan. 13, 1923.

Sericite, a fine-grained variety of muscovite, was shipped during 1929 and 1931. The 1931 output came from two properties in Imperial County. This is the first commercial production of this material in California. This type of material is used as a cheap grade of ground

mica for roofing, as a refractory, foundry facing, and decorative material to imitate snow.

Production of mica in California has been as follows:

Year	Tons	Value
1902	50	$2,500
1903	50	3,800
1904	50	3,000
1929, 1930, 1931*	2,240	15,260
Totals	2,390	$24,560

* Annual details concealed under 'Unapportioned.'

Classification and Uses.

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch; splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ x 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

As a heat-resisting transparent medium, sheet mica has various uses. It is widely employed for stove windows, though this use has declined to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantels, and also for military lanterns and in lantern slides.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, drivers' helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle packings, in pipe and boiler coverings, in fireproof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as 'Santa Claus snow' for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

MINERAL PAINT

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXI, XXII–XXVI (inc.). Bulletins 38, 91.

Mineral paint material was produced in California during 1930 and 1931 by a single operator in Placer County. The details are under 'Unapportioned' to conceal his output. This was a decrease in both

quantity and value from the 1929 output, which was 467 short tons, worth $2,820.

There has been a steady production of mineral paint in California since 1890, when the first recorded production was made. This material came from Alameda, Amador, Butte, Calaveras, Colusa, Los Angeles, Napa, Nevada, Placer, Riverside, Shasta, Sonoma, Stanislaus and Ventura counties. There are also other deposits that may have possible commercial value, but as yet there have been no commercial shipments from El Dorado, Imperial, Kern, Kings, Lake, Mendocino, San Diego, Siskiyou, Trinity and Yuba counties, in which they are found.

California mineral paints have been used as the color pigments in mortar, stucco, and cement mixes in kalsomine, pigments in oil paint, various fillers, in lineoleum, in cosmetics, etc. Their colors vary greatly, as also their composition; yellow, the most common, is colored by limonite; red is colored from hematite; the browns might be colored with either or both hematite or limonite, all of which are mixed with more or less clay. There are several plants in the state that treat their ochers, and blend them to give uniform colors and quality at all times. The color of the materials as they come from the mine will vary, but when properly handled a uniform quality and color can be maintained.

These deposits are found either as soft fine-grained red shales, as gossan after sulphide ore bodies, as yellow or brown clays colored by water carrying iron in solution and depositing it on the clay or from spring waters high in iron which deposit an iron oxide or hydroxide.

Besides the natural deposits, tailings from chlorination plants, pyrite sinter from acid works and magnetite concentrated from black sand have been used in the manufacture of synthetic ochers.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1912	300	$1,800
1891	22	880	1913	303	1,780
1892	25	750	1914	132	847
1893	590	26,795	1915	311	1,756
1894	610	14,140	1916	643	3,960
1895	750	8,425	1917	520	2,700
1896	395	5,540	1918	728	4,738
1897	578	8,165	1919	1,780	17,055
1898	653	9,698	1920	779	8,477
1899	1,704	20,294	1921	446	4,748
1900	529	3,993	1922	1,620	13,277
1901	325	875	1923	1,049	11,773
1902	589	1,533	1924	532	5,234
1903	2,370	3,720	1925	669	6,969
1904	270	1,985	1926	569	5,846
1905	754	4,025	1927	*	*
1906	250	1,720	1928	919	9,592
1907	250	1,720	1929	467	2,820
1908	335	2,250	1930	*	*
1909	305	2,325	1931	*	*
1910	200	2,040			
1911	186	1,184	Totals	22,897	$219,098

*Annual details concealed under 'Unapportioned.'

MINERAL WATER

Bibliography: State Mineralogist Reports VI, XII–XVIII (inc.), XXI–XXVII (inc.). U. S. G. S., Water Supply Paper 338. Min. Res, 1914, 1916. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson, 1890. U. S. Dept. of Agr., Bur. of Chem., Bulletin 91.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the

Fales Hot Springs, Mono County.

Photo by Walter W. Bradley

hot springs are not suitable for drinking, but are very efficacious for bathing.

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least three localities in California: At The Geysers in Sonoma County, Arrowhead Hot Springs in San Bernardino County, and Paraiso Springs, Monterey County. It doubtless exists at others, but the State Division of Mines has not as yet had funds available to conduct the necessary investigations along this line.

So far as the efficacy of radioactivity in mineral water is concerned, it has been found by investigations of the U. S. Geological Survey and the U. S. Department of Agriculture that it is not retained and transported in bottled water. Radioactivity in water is only temporary, and dissipates. To obtain whatever therapeutic effect it may possess, radioactive water should be utilized directly at the spring.

Commercial production of mineral water in California during 1931 amounted to 26,164,331 gallons valued at $1,347,860. This was a decrease in both quantity and value from the 1930 figures, which were 37,354,111 gallons worth $2,870,663 and the largest annual output ever reported in the state. The 1931 output was distributed by counties as follows:

Counties	*Gallons*	*Value*
Lake	24,916	$14,034
Los Angeles	11,618,905	620,851
Napa	106,062	49,665
Sonoma	44,576	8,227
Butte, Calaveras, Colusa, Contra Costa, Fresno, Kern, Orange, Placer, Riverside, San Bernardino, San Diego, San Francisco, San Luis Obispo, Santa Barbara, Santa Clara, and Siskiyou *	14,369,872	655,083
Totals	26,164,331	$1,347,860

* Combined to conceal the output of a single operator in each.

The production above tabulated either came from springs or artesian wells, and was bottled, in part with artificial carbonation, but mostly natural, and sold for drinking purposes. A large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value, as may be noted from the tabulation below, with the exception of 1928, and which shows a decreased value.

Mineral Water Production of California, by Years.

Mineral water was bottled for sale, at the Napa Soda Springs, Napa County, as early as 1860, and at other springs in California, notably The Geysers, Sonoma County, also at early dates; but there are no figures available earlier than the year 1887. Amounts and values, annually, since that year are shown herewith:

Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1910	2,335,259	$522,009
1888	1,112,202	252,990	1911	2,637,669	590,654
1889	808,625	252,241	1912	2,497,794	529,384
1890	258,722	89,786	1913	2,350,792	599,748
1891	334,553	139,959	1914	2,443,572	476,169
1892	331,875	162,019	1915	2,274,267	467,738
1893	383,179	90,667	1916	2,273,817	410,112
1894	402,275	184,481	1917	1,942,020	340,566
1895	701,397	291,500	1918	1,808,791	375,650
1896	808,843	337,434	1919	2,233,842	340,117
1897	1,508,192	345,863	1920	2,391,791	421,643
1898	1,429,809	213,817	1921	3,446,278	367,476
1899	1,338,537	406,691	1922	4,276,346	486,424
1900	2,456,115	268,607	1923	5,487,276	616,919
1901	1,555,328	559,057	1924	8,159,211	818,726
1902	1,701,142	612,477	1925	12,115,072	1,230,455
1903	2,056,340	558,201	1926	14,074,877	1,171,550
1904	2,430,320	496,946	1927	16,644,423	1,487 183
1905	2,194,150	538,700	1928	25,049 002	1,304,969
1906	1,585,690	478,186	1929	27,032,083	2,040,615
1907	2,924,269	544,016	1930	37 354,111	2,870 663
1908	2,789,715	560,507	1931	26,164,231	1,347,860
1909	2,449,834	465,488			
			Totals	237,171,898	$26,910,630

PHOSPHATES

Bibliography: State Mineralogist Report XXI. Bulletins 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XVIII, XXII–XXVII (inc.). Bulletin 38. U. S. Bureau of Mines I. G. 6560. (See 'Tufa.')

The production of pumice and volcanic ash in California during the year 1931 amounted to 11,711 short tons valued at $108,130, coming from two properties each in Fresno, Imperial, Inyo and Siskiyou counties and a single property each in Kern, Mono, San Bernardino and San Luis Obispo counties. The 1931 output showed a decrease from that of 1930, which was 12,947 tons worth $128,847.

The material from Imperial, Inyo, Mono, San Bernardino, and Siskiyou counties was pumice and scoria—the vesicular block variety, and was used in acoustic plaster, light-weight aggregate in concrete, and for abrasive purposes. The product from Fresno, Kern and San Luis Obispo was the volcanic ash, or tuff variety, and was employed in making soap, cleanser compounds, and a large tonnage is being utilized as a concrete filler in cement displacement. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

Pumice Production of California, by Years.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

Year	Tons	Value	Year	Tons	Value
1909	50	$500	1921	406	$6,310
1910			1922	613	4,248
1911			1923	2,936	16,309
1912	100	2,500	1924	4,919	33,404
1913	3,590	4,500	1925	5,319	32,937
1914	50	1,000	1926	7,170	48,350
1915	380	6,400	1927	13,779	168,896
1916	1,246	18,092	1928	10,440	105,055
1917	525	5,295	1929	10,449	76,123
1918	2,114	28,669	1930	12,947	128,847
1919	2,388	43,657	1931	11,711	108,130
1920	1,537	25,890			
			Totals	92,669	$865,112

PYRITES

Bibliography: State Mineralogist Reports XVIII, XIX, XXII, XXV, XXVI, Bulletins 38, 91. Min. and Sci. Press, Vol. 144, pp. 825, 840.

A total production of 25,402 short tons of pyrite, valued at $131,174 was reported shipped in California during 1931, coming from properties in Alameda and Shasta counties. This was a decrease in both quantity and value from the 1930 output, which was 39,958 tons worth $194,228. This material was mostly used in the manufacture of sulphuric acid for explosives and fertilizer. Some iron sulphate has been produced previously and was utilized directly in the preparation of an agricultural fertilizer and insecticide. The sulphur content ranged up to 50.8 per cent S.

This does not include the large quantities of pyrite, chalcopyrite, and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

Pyrites Production in California, by Years.

The total recorded pyrites production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1916	120,525	$372,969
1899	5,400	28,620	1917	111,325	323,704
1900	3,612	21,133	1918	128,329	425,012
1901	4,578	18,429	1919	147,024	540,300
1902	17,525	60,306	1920	146,001	530,581
1903	24,311	94,000	1921	110,025	473,735
1904	15,043	62,992	1922	151,381	570,425
1905	15,503	63,958	1923	148,004	555,308
1906	46,689	145,895	1924	124,214	517,835
1907	82,270	251,774	1925	129,500	528,550
1908	107,081	610 335	1926	100,896	466,088
1909	457,867	1,389,802	1927	130,910	564 823
1910	42,621	179,862	1928	90,566	400,627
1911	54,225	182,954	1929	79,169	363,717
1912	69,872	203,470	1930	39,958	194,228
1913	79,000	218,537	1931	25,402	131,174
1914	79,267	230,058			
1915	92,462	293,148	Totals	2,985,585	$11,044,399

SHALE OIL

Bibliography: State Mineralogist Report XIX. U. S. Geol. Surv., Bulletins 322, 729. U. S. Bur. of Mines, Bull. 210. Eng. and Min. Jour.-Press, Vol. 118, No. 8, pp. 290–292, Aug. 23, 1924. Chem. & Met. Eng., Vol. 32, No. 6, Feb., 1925. Min. Congress Jour., Dec., 1924.

Oil shale is defined by Gavin,[1] as follows:

"Oil shale is a compact, laminated rock of sedimentary origin, yielding over 33 per cent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum."

* * * * * * *

"Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation, or pyrolysis, yields oils somewhat similar to petroleum. These substances have been termed 'kerogen,' from two Greek words meaning producer of wax."

The Scottish oil shales are also known as 'torbanite.'

The so-called 'oil shales' of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in this state are part of the Monterey formation of Tertiary age, and physically and chemically are different from the oil shales of Scotland and from other oil shales in the United States. The mineral matter of this shale is diatomaceous; the beds that yield oil occur in massive formation; and when freshly broken smell strongly of petroleum. Most geologists consider the Monterey shales to have been the origin of the oil in some of the oil fields of California.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France, and Australia, it has not attained any great commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have operated in California, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants. There was no production reported for 1931.

Shale Oil Production of California, by Years

Year	*Barrels*	*Value*
1922–1923*	4,333	$44,262
1924–1925*	8,688	55,240
1926–1927*	8,819	9,998
1928	----	----
Totals	21,840	$109,500

* Annual details concealed under 'Unapportioned.'

[1] Gavin, M. J., Oil Shale, An Historical, Technical, and Economic Study: U. S. Bur. of Mines, Bull. 210, p. 26, 1924.

SILICA (Sand and Quartz)

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII, XVIII, XX–XXVII (inc.). Bulletins 38, 67, 91.

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux, and for steel-casting molds. A portion of the silica sold (both sand and quartz) is also used in glazes for procelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water glass') and glass. Manufacturers of paint use finely-ground silica, which forms as much as one-third of the total pigment in some paints. For certain purposes finely-ground crystalline material is superior in paints to other materials because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear afford a good surface for repainting. The same angularity makes artifically comminuted crystalline quartz superior to natural sand for use in wood fillers. It is also preferable for soaps and polishing powders. Part of the 1925 output was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California during 1931 amounted to 43,330 short tons valued at $182,769 f.o.b. railroad, coming from eleven properties in eight counties, viz: Contra Costa, El Dorado, Mariposa, Monterey, Placer, Riverside, San Diego, and San Bernardino. This was an increase in both quantity and value over the 1930 output of 17,802 tons worth $71,380. Of the above 1931 total 38,788 tons were glass sand and 4542 tons of vein and boulder quartz. The glass sand came from Contra Costa, Monterey, and part of that from Riverside counties. In the past year, for making the higher grades of glass, a deposit in Contra Costa County is now replacing some of the sand imported from Belgium. Belgium sand has also displaced local material in the manufacture of sodium silicate ('water glass'). There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, Contra Costa, El Dorado, Imperial, Los Angeles, Mariposa, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin and Tulare, the chief centers being Contra Costa, Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such,

it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

The Tariff Act of June 21, 1930, placed a duty on sand, containing 95 per cent or more of *Silica* and not more than six-tenths of 1 per cent of oxide of iron and suitable for use in the manufacture of glass, of $2 per ton.

Total Silica Production in California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1916	20,880	$48,908
1900	2,200	2,200	1917	19,376	41,166
1901	5,000	16,250	1918	23,257	88,930
1902	4,500	12,225	1919	18,659	101,600
1903	7,725	7,525	1920	25,324	96,793
1904	10,004	12,276	1921	10,569	49,179
1905	9,257	8,121	1922	9,874	31,016
1906	9,750	13,375	1923	7,964	30,420
1907	11,065	8,178	1924	6,808	35,006
1908	9,255	22,045	1925	12,498	96,780
1909	12,259	25,517	1926	30,010	104,317
1910	19,224	18,265	1927	24,636	94,762
1911	8,620	8,672	1928	14 814	66 679
1912	13,075	15,404	1929	18,686	79,210
1913	18,618	21,899	1930	17,8 2	71,380
1914	28,538	22,688	1931	43,330	182,169
1915	28,904	34,322	Totals	505,481	$1,460,377

SILLIMANITE–ANDALUSITE–CYANITE GROUP

Bibliography: State Mineralogist Reports XX, XXIII, XXIV. XXVII. Bulletins 67, 91. Dana's Mineralogy. U. S. Geol. Surv., Prof. Paper 110. U. S. Bureau of Mines, Inform. Circ. 6255. Eng. & Min. Jour.-Press, Vol. 120, pp. 91–94, 1925. Amer. Mineralogist, June, 1924.

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteristics. Though both crystallize in the orthorhombic system, their crystal habits are different, andalusite being usually in coarse prismatic forms, the prisms nearly square in shape; also occurs massive, imperfectly columnar, and sometimes radiated and granular. Sillimanite commonly occurs in long, slender crystals, not distinctly terminated; prismatic faces striated and rounded; often in close parallel groups, passing into fibrous and columnar massive forms, sometimes radiating. Colors are similar. Hardness, andalusite 7.5, sillimanite 6–7. Andalusite is slightly lighter in specific gravity.

A massive deposit of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Porcelain Company of Detroit, Michigan. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs, for other high-tension electric insulators, laboratory ware and porcelain. Porcelain made from these minerals can be subjected to sudden and extreme changes in temperature without damage.

Cyanite is also an aluminum silicate (Al_2SiO_5), of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system. Occurs usually in long-bladed crystals, rarely terminated; hardness 5-7.25; gravity 3.56-3.67 (being heavier than the other two); color, blue. A deposit of cyanite, apparently in quantity, is being developed in Imperial County, near Ogilby, and shipments made to a refractory plant in Los Angeles.

Dumortierite, though differing somewhat in composition from the above, being a basic aluminum silicate ($HAl_8BSi_3O_{20}$), has proved similar in behavior in ceramic work so that it is now being mixed with andalusite for electrical procelains. A deposit of this mineral in Nevada is being mined for that purpose. Occurrences of massive dumortierite are known in Imperial and San Diego counties in this state and there may yet be some commercial possibilities for them.

Total Sillimanite Group Production of California, by Years

Year	*Tons*	*Value*
1922 1923 1924	*	4,584	$98,790
1925 1926	*	4,810	203,000
1927 1928	*	4,276	76,000
1929 1930	*	4,359	198,893
1931		*	*
Totals		18,029	$576,683

* Annual details concealed under 'Unapportioned.'

SOAPSTONE and TALC

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII–XXVII (inc.). Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California during 1931 amounted to 13,472 short tons valued at $109,940. This was a decrease in both quantity and value from the 1930 figures which were 15,861 tons and $154,258. Over 80% of the product was high-grade talc from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper and rubber manufacture, and some in ceramics. The remainder was soapstone and came from Butte, El Dorado and Tuolumne counties. San Bernardino County had two producers and Butte, El Dorado, Inyo and Tuolumne counties had a single producer each.

The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that Californian talc is replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

Composition and Varieties.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone and steatite. The term

'talc' properly includes all forms of the pure mineral, whereas 'steatite' denotes particularly the massive, compact variety, and 'soapstone' the impure, massive forms containing as low as 50% of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness up to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Uses.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitute can be used, there are several which are of great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, 'slip,' and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes, and as a filler in concrete to make it waterproof. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commonly known as 'lava.' Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. 'French chalk' or 'tailor's chalk' is a soft, massive talc. In China, Japan and India, massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is cut into slabs of 1 and 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones, or fabricated into laundry sinks and tubs, laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids and alkalies, and electricity are essential.

Imports.

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers.

During 1931 imports totaling 23,548 short tons, valued at $436,798, as compared with 25,212 tons worth $509,074 during 1930 according to the United States Bureau of Foreign and Domestic Commerce.

The Tariff Act of 1930 places a duty on talc, steatite or soapstone and French chalk; crude or unground of one-fourth of one cent per pound.

Talc Production of California, by Years.

Production was intermittent in the state up to 1912; but there has been a material growth since 1916, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1913	1,350	$6,150
1894			1914	1,000	4,500
1895	25	375	1915	1,663	14,750
1896			1916	1,703	9,831
1897			1917	5,267	45,279
1898			1918	11,780	85,534
1899			1919	8,764	115,091
1900			1920	11,327	221,362
1901	10	119	1921	8,752	130,078
1902	14	288	1922	13,378	197,186
1903	219	10,124	1923	17,439	252,631
1904	228	2,315	1924	16,179	242,770
1905	300	3,000	1925	15,465	239,084
1906			1926	17,004	255,645
1907			1927	16,218	164,744
1908	3	48	1928	18 668	251.372
1909	33	280	1929	18,676	193,493
1910	740	7,260	1930	15,861	154 258
1911			1931	13,4.2	109,940
1912	1,750	7,350	Totals	217,638	$2,742,637

STRONTIUM

Bibliography: State Mineralogist Report XXVI, XXVII. Bulletins 67, 91. U. S. G. S., Bull. 540; 660–I.

There has been no production of strontium minerals in California since 1918, though in that year both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the only considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped.

Production of strontium minerals in California, by years, has been as follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,000
1918	2,900	33,000
1919		
Totals	6,007	$72,850

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Coston and Bengal

lights and fireworks. It is imported mainly from Germany and England. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable, as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR

Bibliography: State Mineralogist Reports IV, XIII, XIV, XXV. Bulletins 38, 67, 91.

During 1931 there was a small output of sulphur rock in California. From 1929 there has been a small annual production of this material coming from Colusa County and being utilized in the manufacture of a fertilizer and in dusting for mildew. The annual details are concealed in the 'Unapportioned' item so as not to reveal the figures of a single operator. This was the first commercial output of native sulphur for several years, the last previous production was in 1923 and 1924 and came from Kern County. This mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura counties.

The most important use of sulphur is in the making of sulphuric acid used in turn in manufacture of superphosphate fertilizers, chemicals, dyes and explosives; in steel pickling and galvanizing; refining of petroleum, in sugar industry, in storage battery and many other purposes. Other uses of sulphur are the making of sulphur dioxide (SO_2); in agriculture (fertilizer and insecticide); in the manufacture of rubber; and in the manufacture of carbon tetrachloride.

The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that three large companies operating there are capable of producing more than 2,500,000 tons annually in excess of our normal consumption in the United States, which averages about 1,000,000 tons. The mines at Freeport, Texas, are in a peculiarly favorable location in that they are practically at tidewater.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1931 a total of 407,586 long tons valued at $8,836,000 was exported from the United States, principally to Europe and Canada, also Australia, New Zealand, Mexico and South America. The 1931 figures showed a decrease from those of 1930 which were 593,312 long tons and $12,416,233.

Total Production of Sulphur in California.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865–1868 (inc.); following which the property became more valuable for its quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

Production of sulphur in California to date:

Year	*Tons*	*Value*
1865 1866 * 1867	941	$53,500
1868 to 1922	----	------
1923 1924 *	185	4,071
1925 to 1928	----	------
1929 1930 * 1931	265	9,025
Totals	1,391	$66,596

* Annual details concealed under 'Unapportioned.'

CHAPTER SIX

SALINES

Bibliography: State Mineralogist Reports III, XIV, XV, XVII–XXVII (inc.). Bulletin 24. Spurr and Wormser, "Marketing of Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, and in 1926 joined by bromide, and in 1931 by iodine. The nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group showed an increase to $11,779,513 in 1931 over the 1930 figures which were $9,943,500. This increased value was due to higher values being reported by the producers of borax and salt, and the addition of iodine to the group. The 1931 output of these materials is the highest on record. The following table gives details for the years 1930 and 1931:

Substance	1930		1931		Increase+ Decrease— Value
	Tons	Value	Tons	Value	
Borates	209,969	$3,686,817	206,405	$5,753,037	$2,066,220+
Salt	347,945	1,167,487	330,951	1,233,567	66,080+
Soda	90,122	1,627,344	78,701	1,217,811	409,533—
Unapportioned		[a]3,461,852		[b]3,575,098	113,246+
Total values		$9,943,500		$11,779,513	
Net increase					$1,836,013

[a] Includes bromine, calcium chloride, magnesium salts and potash.
[b] Includes bromine, calcium chloride, iodine, magnesium salts and potash.

BORATES

Bibliography: State Mineralogist Reports III, X, XII–XV (inc.), XVII–XXIII (inc.), XXV–XXVII (inc.). Bulletins 24, 67, 91.

During 1931 there was produced in California a total of 203,755 tons of borate materials, compared with 215,986 tons for the year 1930. The material shipped during the year included the new sodium borates, kernite (rasorite), kramerite and some colemanite from Kern County; also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County and Owens Lake in Inyo County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of com-

merce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40 per cent, A. B. A. This is approximately the average A. B. A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1931 production totaled 206,405 short tons valued at $5,753,037. This was a slight decrease in tonnage, but an increase in value over the 1930 output, which was 209,869 tons worth $3,686,817.

Colemanite is a calcium borate, and the material mined is shipped to seaboard chemical plants for refining. The latest development in the borax industry is the finding in quantity and opening up of a group of new borate minerals which have now supplanted colemanite in much the same way that colemanite deposits displaced the borax industry in the desert playas or dry lakes, some forty years ago. These new minerals are 'kernite' (or 'rasorite'), a sodium borate with a smaller water-of-crystallization content than the 'borax' of commerce, so that when recrystallized to borax, the resulting product has an increased weight over the original material, and kramerite, a hydrous sodium-calcium borate. These deposits are being mined by the Pacific Coast Borax Company, Suckow Borax Mines, Inc., and Western Borax Company, in southeastern Kern County.

Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steelware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats. Among the newer uses for borax is its employment in the preserving of citrus fruits by washing them in a solution of borax, which closes the pores of the skin. The application of this process is stated to be important in California and Florida. Another is as a preservative of wood, in addition to which borax, being noninflammable, renders it fireproof.

The total amount of borates exported from the United States[1] during the year 1931 was 86,938 short tons valued at $3,358,609, as compared with 82,931 tons worth $3,057,794 in 1930.

Total Production of Borate Materials in California.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County was discovered in September of the same year by Dr. John A. Veach. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea, to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

[1] Monthly Summary of Foreign Commerce of the United States, Department of Commerce, Dec., 1931, Part 1.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County, and later similar beds in Inyo and Los Angeles counties. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities. Some production of colemanite has been made from deposits opened up in Clarke County, Nevada.

The total production of borate materials in California is shown in the following table:

Total Production of Borate Materials in California

Year	Tons	Value	Year	Tons	Value
1864	12	$9,478	1899	20,357	$1,139,882
1865	126	94,099	1900	25,837	1,013,251
1866	201	132,538	1901	22,221	982,380
1867	220	156,137	1902	[1]17,202	2,234,994
1868	32	22,384	1903	34,430	661,400
1869			1904	45,647	698,810
1870			1905	46,334	1,019,158
1871			1906	58,173	1,182,410
1872	140	89,600	1907	53,413	1,200,913
1873	515	255,440	1908	22,200	1,117,000
1874	915	259,427	1909	16,628	1,163,960
1875	1,168	289,080	1910	16,828	1,177,960
1876	1,437	312,537	1911	50,945	1,456,672
1877	993	193,705	1912	42,135	1,122,713
1878	373	66,257	1913	58,051	1,491,530
1879	364	65,443	1914	62,500	1,483,500
1880	609	149,245	1915	67,004	1,663,521
1881	690	189,750	1916	103,523	2,409,375
1882	732	201,300	1917	109,944	2,561,958
1883	900	265,500	1918	88,772	1,867,908
1884	1,019	198,705	1919	66,791	1,717,192
1885	942	155,430	1920	127,065	2,794,206
1886	1,285	173,475	1921	50,136	1,096,326
1887	1,015	116,689	1922	[2]39,087	1,068,025
1888	1,405	196,636	1923	62,667	1,893,798
1889	965	145,473	1924	52,070	1,599,149
1890	3,201	480,152	1925	46,124	1,526,938
1891	4,267	640,000	1926	47,605	1,625,298
1892	5,525	838,787	1927	72,462	3,043,260
1893	3,955	593,292	1928	109,722	3,378,552
1894	5,770	807,807	1929	144,678	3,312,085
1895	5,959	595,900	1930	209,869	3,686,817
1896	6,754	675,400	1931	206,405	5,753,037
1897	8,000	1,080,000			
1898	8 300	1,153,000	Totals	2,264,614	$70,746,644

[1] Refined borax. [2] Recalculated to 40% 'anhydrous boric acid' equivalent beginning with 1922.

BROMINE

The first commercial production of bromine and bromine compounds was begun during 1926 by the California Chemical Corporation in its plant at Chula Vista, San Diego County, from salt works bittern waters. This same plant has been recovering magnesium chloride for a number of years. A small amount of bromine was also reported made at a similar bittern-water plant at Newark, Alameda County. The total commercial production of bromine in California for 1926–1928 inclusive amounted to 158 short tons valued at $120,480, while that for 1929–1931 amounted to 802 tons worth $552,933. The annual details are concealed under the 'Unapportioned' item.

A large part of the bromine output of the United States is not sold as bromine, but in the form of potassium and sodium bromides and

other salts. The principal production in the United States has come from bitterns from salt wells in Michigan, Ohio and West Virginia.

The best known uses of bromine are its application in the form of silver bromide in photography and the manufacture of ethyl gasoline. Production in California has increased rapidly the past six years on account of the last named above. Bromine, as such, was used extensively in the European War in making asphyxiating gases. It also has some uses in medicine, particularly in the treatment of nervous diseases.

CALCIUM CHLORIDE

Bibliography: U. S. Geol. Surv., Min. Res. 1919, Pt. II. Engineering and Contracting, Roads and Streets, monthly issue, Feb. 6, 1924. 'How to Maintain Roads,' manual of instruction of Dow Chemical Company.

Calcium chloride is hygroscopic, that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

Total Calcium Chloride Production in California.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes.

During 1930 the production of calcium chloride in California came from San Bernardino County from two plants. The annual details are concealed under the 'Unapportioned' item to conceal the output of either operator. Total production in California in shown in the following tabulation:

Year	Tons	Value
1921	683	$22,980
1922 *		
1923	1,204	26,580
1924 *		
1925	10,988	328,876
1926 *		
1927	34,195	508,748
1928 *		
1929	12,020	114,080
1930	9,688	103,237
1931		
Totals	68,778	$1,104,501

* Annual details concealed under 'Unapportioned.'

IODINE

Bibliography: U. S. Bureau of Mines I. C. 6387.

Iodine was first produced in California during 1917 to 1921 as a by-product of potash which was reduced from kelp in an experimental station of U. S. Department of Agriculture at Summerland, but after the armistice the demand for these minerals decreased so that the plants in Santa Barbara County closed. In 1929 the General Salt Company erected a plant which reduces iodine from the waste waters of the deep oil wells in the Long Beach field. Their production is more or less in the experimental stage. Annual details are concealed under the 'Unapportioned' item so as not to reveal the output of a single operator.

The salts of iodine are used as chemical agents in photography as a fertilizer and as a medicine. The lack of this element in the human system is said to be the cause of goiter, therefore it is sometimes added to drinking water and to table salt. A solution of iodine in alcohol is used as a common antiseptic and disinfectant.

MAGNESIUM SALTS

Bibliography: State Mineralogist Reports XX, XXI, XXV–XXVI (inc.). Bulletin 91. 'Dictionary of Applied Chemistry,' by Thorpe. U. S. Geol. Surv., Min. Res. of P. S.

The 1931 production of magnesium salts in California is concealed under 'Unapportioned.' This was the chloride and the carbonate. The chloride was nearly all sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for road liquor. The carbonate, a bulky white powder, was used as a heat-insulating material, as a filler for rubber, paper, paint, etc., and in medicines, in tooth paste, in face powder and as a polish for metal and glass. The sulphate marketed was utilized for medicinal and bath purposes. The material coming from San Diego County was residual bitterns from the salt plants and was in part marketed in the liquid form carrying from 35 per cent to 67 per cent $MgCl_2$ and in part as dry crystals, while that from San Mateo County was magnesium carbonate.

The use of magnesite cement and stucco in building construction on the Pacific coast has created a market for magnesium chloride here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1931 was approximately $30 per ton, f.o.b. plant.

Total Production of Magnesium Salts in California.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or 'epsom salts' is also made, annually, but in smaller amount, and magnesium carbonate by a patented process, direct from sea water.

The total production of magnesium salts in California, since the beginning of the industry here, is shown in the following tabulation:

Year	Tons	Value
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
1922	3,036	89,788
1923	3,662	116,031
1924	4,823	145,883
1925	4,221	132,553
1926	4,881	124,470
1927	*	6,241	139,589
1928			
1929	*	4,914	333,906
1930			
1931		*	*
Totals		43,620	$1,449,939

* Annual details concealed under 'Unapportioned.'

NITRATES

Bibliography: State Mineralogist Report XV, XXV, XXVI, XXVII. Bulletins 24, 67, 91. U. S. G. S., Press Bulletin No. 373, July, 1918. Smithsonian Inst., Publ. No. 2421, 1916.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

POTASH

Bibliography: State Mineralogist Reports XV, XVIII, XX, XXII, XXV, XXVII (inc.). Bulletins 24, 67, 91. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62 Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789. Eng. & Min. Jour.-Press, Vol. 117, p. 557, Apr. 5, 1924.

The 1931 production of potash in California came from a single operator in San Bernardino County, the details of which are concealed under the 'Unapportioned' item. This was principally chloride and the product averaged 60% equivalent K_2O content. The material was sold mainly for fertilizer manufacture.

Imports of crude potash minerals and salts into the United States during 1931, according to the U. S. Bureau of Foreign and Domestic

Commerce, amounted to 472,626 long tons valued at $12,237,226, compared with 833,872 long tons worth $19,909,797 in 1930. These materials consisted mainly of 'manure salts,' crude chloride (muriate) and sulphate, and kainite, all of which are admitted duty free.

Quotations have recently ranged from $48.25 per ton c.i.f. Atlantic and Gulf ports for high-grade sulphate (90%–95%), $35 per ton for muriate (80%–85%), and $19 for manure salts (30%).

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography and medicine.

Total Production of Potash in California.

Potash production began commercially in California in 1914, with a small yield from kelp. The bulk of the output comes from deposits of potash-bearing residues and brines in the old lake beds of the desert regions, particularly Searles Lake, San Bernardino County. A small amount has been made from salt-works bitterns, and for a time there was some from Portland cement dust. Some also has been obtained from molasses distillery-slops char.

The annual amounts and value of these potash materials, since their beginning in California in 1914, have been as follows:

Total Production of Potash in California

Year	Tons	Value
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
1922	17,776	584,388
1923	29,597	709,836
1924	33,107	747,407
1925	36,355	829,770
1926	32,884	812,285
1927	67,340	1,952,852
1928, 1929	* 178,680	5,522,350
1930, 1931	* 172,263	5,500,536
Totals	834,621	$32,632,381

* Annual details concealed under 'Unapportioned.'

SALT

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXIII (inc.), XXV–XXVII. Bulletins 24, 67, 91. U. S. Geol. Survey, Bull. 669. U. S. Bur. of Mines, Bull. 146.

Most of the salt production in California is obtained by evaporation of water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions (in part, rock salt), mainly in Inyo, Kern and San Bernardino

counties, and evaporation of alkaline lake water in Modoc County. A small amount of valuable medicinal salts has been obtained by evaporation of the water of Lake Mono, Mono County.

During 1931 in California there was an output of 330,951 short tons of salt valued at $1,233,567, compared with the 1930 yield which was 347,945 tons worth $1,167,487. There were eleven plants operating in 1931, two each in Alameda and San Bernardino counties and one each in Kern, Los Angeles, Modoc, Mono, Monterey, San Diego and San Mateo.

The average value reported for salt produced in California during 1931 was $3.73 per ton f.o.b. plant as compared with $3.36 in 1930, $6.80 in 1929 and $3 in 1928.

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1910	174,920	$395,417
1888	30,800	92,400	1911	173,332	324,255
1889	21,000	63,000	1912	185,721	383,370
1890	8,729	57,085	1913	204,407	462,681
1891	20,094	90,303	1914	223,806	583,553
1892	23,570	104,788	1915	169,028	368,737
1893	50,500	213,000	1916	186,148	455,695
1894	49,131	140,087	1917	227,825	584,373
1895	53,031	150,576	1918	212,076	806,328
1896	64,743	153,244	1919	233,994	896,963
1897	67,851	157,520	1920	230,638	972,648
1898	93,421	170,855	1921	197,989	832,702
1899	82,654	149,588	1922	223,238	819,187
1900	89,338	204,754	1923	275,979	1,130,670
1901	126,218	366,376	1924	318,800	1,159,137
1902	115,208	205,876	1925	284,068	949,826
1903	102,895	211,365	1926	311,761	1,124,978
1904	95,968	187,300	1927	263,028	639,127
1905	77,118	141,925	1928	340,580	1,024,656
1906	101,650	213,228	1929	392,039	2,665,436
1907	88,063	310,967	1930	347,945	1,167,487
1908	121,764	281,469	1931	330,951	1,233,567
1909	155,680	414,708			
			Totals	7,174,699	$23,173,207

SODA

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XXX, XXII, XXIII, XXV–XXVII (inc.). Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 717.

The production of sodium salts in California in 1931 included: Soda ash, trona, caustic soda and bicarbonate from plants at Owens Lake, Inyo County, and trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County. There were no shipments of salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County, in 1931. The output for the year amounted to 78,701 short tons valued at $1,217,811, compared with the 1930 figures which were 90,122 tons and $1,627,344.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, paper, oil refining, sugar refining, and chemicals; and the trona for metallurgical purposes.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning,

sugar refining, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1914	6,522	$115,396
1895	1,900	47,500	1915	5,799	83,485
1896	3,000	65,000	1916	10,593	264,825
1897	5,000	110,000	1917	24,505	928,578
1898	7,000	154,000	1918	20,447	855,423
1899	10,000	250,000	1919	21,294	721,958
1900	1,000	50,000	1920	32,407	1,164,898
1901	8,000	400,000	1921	14,828	438,996
1902	7,000	50,000	1922	20,084	573,661
1903	18,000	27,000	1923	34,885	764,284
1904	12,000	18,000	1924	32,536	711,796
1905	15,000	22,500	1925	48,625	947,649
1906	12,000	18,000	1926	63,333	1,305,802
1907			1927	62,571	1,478,239
1908	9,600	14,400	1928	80,838	1,469,297
1909	7,712	11,593	1929	90,646	1,838,657
1910	8,125	11,862	1930	90,122	1,627,344
1911	9,023	52,887	1931	78,701	1,217,811
1912	7,200	37,094			
1913	1,861	24,936	Totals	983,687	$17,892,871

CHAPTER SEVEN

BY COUNTIES

Introductory.

The State of California includes a total area of 158,297 square miles, of which 155,652 square miles are of land. The maximum width is 235 miles, the minimum 148 miles, and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1930 census figures show a total population for California of 5,672,009. Minerals of commercial value exist in every county, and during 1930 some active production was reported to the State Division of Mines from all of the fifty-eight, with one exception.

Rank of Counties in Mineral Yield, 1931.

Of the ten leading counties in point of total value of output for 1931, the first six, Los Angeles, Kern, Kings, Ventura, Orange, and Santa Barbara owe their position to petroleum and natural gas. Los Angeles, due to crude oil, leads all the others, being credited with 37 per cent of the entire state's total value in 1931, having passed Kern in 1923, which led the state for many years. San Bernardino (seventh) owes its place to cement, potash, and borates; Nevada (eighth) to gold; Riverside (ninth) to cement; and Alameda (tenth) to miscellaneous stone and salt.

There were twenty counties each having a total mineral production in excess of a million dollars in 1931. Petroleum was an important item in seven; cement and natural gas in five each; gold in four; miscellaneous stone and borax in two each; and brick, copper diatomite, salt, and soda in one each. In point of variety and diversity, San Bernardino County led all others in 1931 with a total of twenty-six different mineral products on its commercial list; followed by Kern with nineteen; Los Angeles with eighteen; Fresno and San Diego with seventeen each; Inyo and Riverside with sixteen each; Santa Barbara with fifteen; El Dorado and Placer with twelve each; Butte, San Luis Obispo, Tulare and Tuolumne with eleven each; Amador, Calaveras, Monterey, Sacramento, Shasta, and Ventura with ten each. The counties with their mineral resources, production for 1931, etc., are considered in detail in the following paragraphs:

	County	Value		County	Value
1.	Los Angeles	$79,469,897	31	San Joaquin	$462,196
2.	Kern	28,782,358	32.	El Dorado	437,935
3.	Kings	17,371,901	33.	San Luis Obispo	400,135
4.	Ventura	15,455,727	34.	Napa	396,841
5.	Orange	15,135,148	35.	Tuolumne	377,157
6.	Santa Barbara	12,714,760	36.	Trinity	328,522
7.	San Bernardino	9,975,484	37.	Placer	285,848
8.	Nevada	3,497,218	38.	Lake	280,768
9.	Riverside	2,526,503	39.	Stanislaus	277,281
10.	Alameda	2,417,925	40.	Sonoma	252,636
11.	Sacramento	2,259,674	41.	Monterey	223,470
12.	Fresno	2,238,333	42.	Mono	201,923
13.	San Mateo	2,230,509	43.	Humboldt	199,986
14.	Amador	2,170,075	44.	Tulare	197,116
15.	Santa Cruz	1,767,134	45.	Mariposa	193,641
16.	Plumas	1,559,296	46.	Siskiyou	187,007
17.	Inyo	1,347,708	47.	Modoc	181,250
18.	Contra Costa	1,328,812	48.	Colusa	118,905
19.	Calaveras	1,093,554	49.	Mendocino	72,707
20.	Yuba	1,022,826	50.	Solano	62,270
21.	San Diego	852,447	51.	Tehama	50,407
22.	Merced	707,789	52.	Glenn	47,462
23.	Sierra	691,365	53.	Del Norte	38,075
24.	Santa Clara	666,300	54.	Yolo	21,500
25.	Shasta	666,086	55.	San Francisco	20,500
26.	San Benito	654,284	56.	Lassen	1,843
27.	Marin	544,760	57.	Alpine	29
28.	Imperial	528,027	58.	Sutter	-------
29.	Madera	488,343			
30.	Butte	482,737		Total	$215,964,420

ALAMEDA

Land area: 732 square miles.
Population: 475,153 (1930 census).
Location: East side of San Francisco Bay.
County seat: Oakland.
References: State Mineralogist Report XVII: XVIII: XX: XXVI (Oct. 1929).

Alameda County, while in no sense one of the 'mining counties,' comes tenth on the list, with a value of mineral production for 1931 of $2,417,925 and having eight different substances. This was a decrease from the 1930 output, which was $2,529,337.

The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, limestone, mineral paint, pyrite, quartz crystals, glass-sand, salt, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	Amount	Value
Brick and hollow building tile	----	$248,569
Clay (pottery)	5,505 tons	3,048
Stone, miscellaneous	----	1,008,124
Other minerals [a]	----	1,158,184
Total value		$2,417,925

[a] Included bromine, limestone (shells), pyrite, salt.

ALPINE

Land area: 776 square miles.
Population: 236 (1930 census).
Location: On eastern border of state, south of Lake Tahoe.
County seat: Markleeville.
References: State Mineralogist Report XV: XVII: XVIII.

This county lies just south of Lake Tahoe, in the high Sierra Nevada. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

Commercial production for 1931 was $29, being a decrease from the 1930 amount, which was $2,500.

AMADOR

Land area: 601 square miles.
Population: 8494 (1930 census).
Location: East-central part of state—Mother Lode District.
County seat: Jackson.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXIII (April, 1927).

The value of Amador County's mineral production decreased from $2,424,687 in 1930 to $2,170,075 in 1931, placing it fourteenth on the list of counties in the state as regards total value of mineral substances marketed. The decrease was due mainly to gold.

Although having an output consisting of ten different minerals the leading product, gold, makes up approximately 64% of the total value for the year.

Amador at one time led the state in gold production, though exceeded in 1920–1923 and in 1926–1927 by Yuba and Nevada counties, but in 1925 and 1928 by Yuba only, in 1929–1930 by Nevada only, and in 1931 by Nevada and Sacramento.

Commercial output for 1931 was as follows:

Substance	*Amount*	*Value*
Clay (pottery)	32,275 tons	$57,751
Gold	-----	1,549,073
Silver	16,494 fine oz.	4,783
Stone, miscellaneous	-----	491,456
Other minerals [a]	-----	67,993
Total value		$2,170,075

[a] Includes brick, coal, copper, lead, marble.

BUTTE

Land area: 1722 square miles.
Population: 34,010 (1930 census).
Location: North-central portion of state.
County seat: Oroville.
References: State Mineralogist Report XV: XVII: XVIII: XXIV (July, 1928): XXVI (Oct., 1930).

Butte, thirtieth county in California in regard to value of its mineral output, reports a commercial production of eleven mineral substances having a total value of $482,737 as compared with $539,666 for 1930. Gold was the most important, and its production had the greatest annual value in this county until 1928, when the value of the output of miscellaneous stone passed that of gold.

Butte stands eleventh among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver and miscellaneous stone.

Commercial output for 1931 was as follows:

Substance	*Amount*	*Value*
Copper	2,108 lbs.	$192
Gold	----	172,383
Silver	2,240 fine oz.	650
Stone, miscellaneous	----	300,225
Other minerals [a]	----	9,287
Total value		$482,737

[a] Includes brick, gems (diamonds), mineral water, natural gas, platinum, soapstone.

CALAVERAS

Land area: 1027 square miles.
Population: 6,009 (1930 census).
Location: East-central portion of state—Mother Lode District.
County seat: San Andreas.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXI (April, 1925).

Calaveras County reported production of ten different minerals, valued at $1,093,554 during the year 1931, as compared with $2,083,956 for 1930. Cement, stone and gold are the chief mineral substances. Calaveras County stands nineteenth among the counties in regard to the total value of mineral output for 1931, and thirteenth in gold.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble, mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

Commercial output for 1931 was as follows:

Substance	*Amount*	*Value*
Copper	184 lbs.	$17
Gold	----	152,771
Lead	4,386 lbs.	162
Silver	3,410 fine oz.	989
Stone, miscellaneous	----	185,810
Other minerals [a]	----	753,805
Total value		$1,093,554

[a] Includes cement, gems (quartz crystals), mineral water, platinum.

COLUSA

Land area: 1140 square miles.
Population: 10,257 (1930 census).
Location: Sacramento Valley.
County seat: Colusa.
References: State Mineralogist Report XIV: XVII: XVIII: XXV (April, 1929).

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1931 mineral production was $118,905, being an increase over the 1930 figure, which was $50,140, giving it forty-eighth place in the order of mineral value, and was as follows:

Substance	*Value*
Stone, miscellaneous	$88,225
Other minerals [a]	30,680
Total value	$118,905

[a] Includes mineral water, quicksilver, sulphur.

CONTRA COSTA

Land area: 714 square miles.
Population: 78,554 (1930 census).
Location: East side of San Francisco Bay.
County seat: Martinez.
References: State Mineralogist Report XVII : XVIII : XXIII (Jan., 1927).

Contra Costa, like Alameda County, lies on the eastern shore of San Francisco Bay, and is not commonly considered among the mineral producing counties of the state. It stands eighteenth on the list in this respect, with an output valued at $1,328,812 for 1931 as compared with $1,643,286 in 1930.

Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Clay (pottery)	5,368 tons	$3,813
Stone, miscellaneous	----	351,825
Other minerals [a]	----	973,204
Total value		$1,328,812

[a] Includes brick and hollow building tile, cement, mineral water, silica (glass sand).

DEL NORTE

Land area: 1024 square miles.
Population: 4734 (1930 census).
Location: Extreme northwest corner of state.
Transportation: Motor, wagon and mule back; steamer from Crescent City.
County seat: Crescent City.
References: State Mineralogist Report XIV: XVII: XXI (July, 1925).

Del Norte almost rivals Alpine County in regard to inaccessibility. Like the latter county, also, given transportation and kindred facilities, this portion of the state presents a field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone.

The 1931 output was a decrease from the figure of $176,030 in 1930, the principal item of which is crushed rock used on highway construction, and rock used on the Crescent City harbor jetty.

Commercial production for 1931, giving it fifty-third place, was as follows:

Substance	*Amount*	*Value*
Gold	----	$1,372
Silver	4 fine oz.	1
Stone, miscellaneous	----	36,702
Total value		$38,075

EL DORADO

Land area: 1753 square miles.
Population: 8303 (1930 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.
County seat: Placerville.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXII (Oct., 1926).

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes thirty-second on the list of counties ranked according to the value of their total mineral production during the year 1931. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The 1931 mineral production of 12 different mineral substances valued at $437,935 was a decrease from the 1930 output worth $493,243.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, slate, soapstone, silver, and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$85,322
Limestone	79,798 tons	207,594
Silver	975 fine oz.	283
Stone, miscellaneous	-----	37,494
Other minerals [a]	-----	107,242
Total value		$437,935

[a] Includes chromite, copper, lead, lime, silica (quartz), slate, soapstone.

FRESNO

Land area: 5950 square miles.
Population: 144,369 (1930 census).
Location: South-central portion of state.
County seat: Fresno.
References: State Mineralogist Report XIV: XVII: XVIII: XXV (July, 1929).

Fresno County, twelfth in importance as a mineral producer among the counties of California, reports an output for 1931 of 17 different mineral substances, with a total value of $2,238,333, a decrease from the 1930 production, which was worth $2,324,473.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$6,512
Natural gas	5,591,304 cu. ft.	253,937
Petroleum	2,991,976 bbls.	1,649,476
Silver	53 fine oz.	15
Stone, miscellaneous	-----	202,748
Other minerals [a]	-----	125,645
Total value		$2,238,333

[a] Includes brick and hollow building tile, chromite, diatomite, gems (topaz) granite, gypsum, limestone (marl), mineral water, volcanic ash, quicksilver.

GLENN

Land area: 1259 square miles.
Population: 10,935 (1930 census).
Location: West side of Sacramento Valley.
County seat: Willows.
References: State Mineralogist Report XIV: XVII: XVIII.

Glenn County, standing fifty-second, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1931 was as follows, being a decrease from $61,179 of the previous year:

Substance	*Value*
Stone, miscellaneous	$47,462

HUMBOLDT

Land area: 3634 square miles.
Population: 43,189 (1930 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.
County seat: Eureka.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (July, 1925).

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until 1915, when railroad communication was established with the outside world, the only method of outside communication was by steamer. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Humboldt ranks forty-third in the value of its mineral output among the counties of the state for 1931 with eight different mineral substances, valued at $199,986 as compared with 1930 output valued at $270,633.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	--	$2,678
Silver	18 fine oz.	5
Stone, miscellaneous	--	194,324
Other minerals [a]	--	2,979
Total value		$199,986

[a] Includes brick, pottery clay, natural gas, platinum.

IMPERIAL

Land area: 4089 square miles.
Population: 60,894 (1930 census).
Location: Extreme southeast corner of the state.
County seat: El Centro.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXII (April, 1926).

During 1931 Imperial County produced eight mineral substances having a total value of $528,027, an increase over the 1930 output, which was $368,023. It ranks twenty-eighth in total value of mineral production for the year. This county contains deposits of cyanite, gold, gypsum, lead, manganese, marble, pumice, salt, silver, sodium and strontium, largely developed.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	----	$649
Silver	2 fine oz.	1
Stone, miscellaneous	----	429,782
Other minerals [a]	----	97,594
Total value		$528,027

[a] Includes gypsum, mica, pumice, cyanite.

INYO

Land area: 10,019 square miles.
Population: 6557 (1930 census).
Location: Lies on eastern border of state, north of San Bernardino County.
County seat: Independence.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXII (Oct., 1926).

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1931 reached a value of $1,347,708, standing seventeenth among the counties of the state in this respect. Sixteen different mineral substances were produced. The 1930 output was valued at $2,260,766. Its mineral resources include antimony, asbestos, barytes, copper, dolomite, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten and zinc.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Copper	8,542 lbs.	$777
Gold	----	40,603
Lead	3,703,232 lbs.	137,020
Silver	142,452 fine oz.	41,311
Soda	56,251 tons	903,511
Other minerals [a]	----	224,486
Total value		$1,347,708

[a] Includes barytes, bentonite, borax, dolomite, lime, limestone, pumice, quicksilver, talc, miscellaneous stone.

KERN

Land area: 8003 square miles.
Population: 82,219 (1930 census).
Location: South-central portion of state.
County seat: Bakersfield.
References: State Mineralogist Report XIV: XVII: XVIII: XXIX: XX: XXV (Jan., 1929).

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all counties of California in the value of its mineral output, the exact figures for 1931 being $28,782,358. Kern was surpassed by both Los Angeles and Orange counties in 1923, but by Los Angeles only in 1924–1931, for which petroleum also is responsible. The 1930 mineral output for this county was worth $42,987,977. The decrease was due mostly to crude oil. During 1931 nineteen different mineral substances were produced.

Commercial production for 1931 was as follows:

Substance	*Amount*		*Value*
Clay (pottery and oil well drilling)	27,499	tons	$46,668
Copper	207	lbs.	19
Gold	----------		202,108
Lead	6,307	lbs.	233
Natural gas	26,977,942	M cu. ft.	1,444,732
Petroleum	35,794,138	bbls.	22,765,072
Silver	8,739	fine oz.	2,534
Stone, miscellaneous	----------		108,958
Other minerals [a]	----------		4,212,034
Total value			$28,782,358

[a] Includes bentonite, borates, brick, cement, feldspar, gypsum, mineral water, volcanic ash, quicksilver, salt.

KINGS

Land area: 1559 square miles.
Population: 25,277 (1930 census).
Location: South-central portion of the state.
County seat: Hanford.
References: State Mineralogist Report XIV: XVII: XVIII: XXVI (Oct., 1930).

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Drilling for oil has been under way, and commercial output recorded for the first time in 1926.

Tulare Lake is in Kings County, though now largely drained, and the land under cultivation.

Kings County advanced from ninth position in 1929 to seventh in value of mineral production for 1930, and third for 1931, accounted for by the bringing in of further oil wells at Kettleman Hills, which began commercial yield in 1928.

Commercial output for 1931 was as follows:

Substance	*Amount*		*Value*
Natural gas	120,253,916	M cu. ft.	$4,636,107
Petroleum	17,607,527	bbls.	12,735,524
Unapportioned	----------		270
Total value			$17,371,901

LAKE

Land area: 1278 square miles.
Population: 7166 (1930 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.
County seat: Lakeport.
References: State Mineralogist Report XIV: XVII: XVIII: XX: XXV (July, 1929).

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are asbestos, borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

Lake County was in thirty-eighth place as to value of mineral output. Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Mineral water	24,916 gals.	$14,034
Quicksilver	3,046 flasks.	251,879
Stone, miscellaneous	-----	14,785
Unapportioned	-----	70
Total value		$280,768

LASSEN

Land area: 4531 square miles.
Population: 12,587 (1930 census).
Location: Northeast portion of state.
County seat: Susanville.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXV (Jan., 1929).

Lassen County is one of the only partly-developed sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been produced, but not for some years, until 1921, when the yield again became important. In fifty-sixth place, commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	----	$241
Silver	6 fine oz.	2
Unapportioned	----	1,600
Total value		$1,843

LOS ANGELES

Land area: 4067 square miles.
Population: 2,201,526 (1930 census).
Location: One of the southwestern coast counties.
County seat: Los Angeles.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXIII (July, 1927).

The mineral production for Los Angeles County for the year 1931 amounted in value to $79,469,897, as compared to the 1930 output worth $171,616,329. This accounted for 37% of the entire state's total for 1931 and ranks Los Angeles first in the state as a mineral producer, having in 1923 passed Kern County, which had previously been leading for several years. The decrease in 1931 was due to petroleum.

Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1931, consisting of eighteen substances, was as follows:

Substance	*Amount*	*Value*
Brick	85,593 M	$907,350
Hollow building tile	11,537 tons	95,357
Clay (pottery)	27,972 tons	25,359
Gold	----------	1,292
Lead	2,245 lbs.	83
Mineral water	11,618,905 gals.	620,851
Natural gas	117,606,814 M cu. ft.	6,489,448
Petroleum	85,382,013 bbls.	66,999,266
Sandstone	----------	1,780
Silver	222 fine oz.	64
Stone, miscellaneous	----------	3,010,537
Other minerals [a]	----------	1,318,510
Total value		$79,469,897

[a] Includes bentonite, cement, diatomite, granite (flagstone), iodine, salt.

MADERA

Land area: 2112 square miles.
Population: 17,152 (1930 census).
Location: East-central portion of state.
County seat: Madera.
References: State Mineralogist Report XIV: XVII: XVIII: XXIV (Oct., 1928).

Madera County produced five different mineral substances during the year 1931, having a total value of $488,343, as compared with the 1930 output worth $675,782, the decrease being due to granite. This county contains deposits of copper, gold, granite, iron, lead, molybdenum, pumice, silver, and miscellaneous stone.

In twenty-ninth place, commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	--	$2,405
Silver	38 fine oz.	11
Stone, miscellaneous	--	2,015
Unapportioned	--	483,912
Total value		$488,343

MARIN

Land area: 529 square miles.
Population: 41,635 (1930 census).
Location: Adjoins San Francisco on the north.
County seat: San Rafael.
References: State Mineralogist Report XIV: XVII: XVIII: XXII (July, 1926).

Mineral production in Marin County during 1931 amounted to $544,760, compared with $405,541 in 1930.

This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

In twenty-seventh place, commercial production for 1931 was as follows:

Substance	*Value*
Unapportioned	$544,760

MARIPOSA

Land area: 1453 square miles.
Population: 2530 (1930 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.
County seat: Mariposa.
References: State Mineralogist Report XIV: XVII: XVIII: XIV (April, 1928).

Mariposa County is one of the distinctly "mining" counties of the state, although it stands but forty-fifth on the list of counties in regard to the value of its mineral output for 1931, with a total of $193,641, as compared wih $143,465 in 1930.

Its mineral resources are varied, among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	----	$88,600
Silver	1,901	551
Stone, miscellaneous	----	33,410
Other minerals [a]	----	71,080
Total value		$193,641

[a] Includes barytes, copper, granite, lead, silica (quartz).

MENDOCINO

Land area: 3453 square miles.
Population: 23,491 (1930 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.
County seat: Ukiah.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX.

Mendocino County's annual mineral production has usually been small, the 1931 output being valued at $72,707, ranking forty-ninth among the counties, as compared with $123,062 in 1930.

Deposits of, in part undetermined value, of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold, platinum, and silver.

Commercial production for 1931 was as follows:

Substance	*Value*
Stone, miscellaneous	$70,755
Other minerals	1,952
Total value	$72,707

MERCED

Land area: 1995 square miles.
Population: 36,900 (1930 census).
Location: About the geographical center of the state.
County seat: Merced.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (April, 1925).

Merced County as a whole lies in San Joaquin Valley and it figures as one of the lesser mineral producing counties of the state. The 1931 mineral output was valued at $707,789, compared with $801,900 in 1930, the decrease being due to cement.

Gold, platinum, and silver were formerly obtained in important amounts by dredging, which ceased in this county in 1918, though a small yield from other sources is still occasionally had. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In twenty-second place, commercial production during 1931 was as follows:

Substance	*Amount*	*Value*
Gold	---	$173,551
Silver	778 fine oz.	226
Other minerals [a]	---	534,012
Total value		$707,789

[a] Includes cement, copper, miscellaneous stone.

MODOC

Land area: 3823 square miles.
Population: 8038 (1930 census).
Location: The extreme northeast corner of the state.
County seat: Alturas.
References: State Mineralogist Report XV: XVII: XVIII: XXV (Jan., 1929).

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are clay, coal, gold, iron, quicksilver, salt, and silver.

In forty-seventh place, commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	--	$293
Silver	6 fine oz.	2
Stone, miscellaneous	--	180,104
Unapportioned	--	851
Total value		$181,250

MONO

Land area: 3030 square miles.
Population: 1359 (1930 census).
Location: Is bordered by the state of Nevada on the east and is about in the central portion of the state measured on a north and south line.
County seat: Bridgeport.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXIII (Oct., 1927).

Gold mining has been carried on in portions of Mono County for many years, although, taken as a whole, it lies in a somewhat inaccessible country so far as rail transportation is concerned. It is in the continuation of the heavily mineralized belt which was noted in Inyo County and contains among other mineral resources andalusite, barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-second place with seven different substances, commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$125,342
Lead	137 lbs.	5
Silver	18,524 fine oz.	5,372
Stone, miscellaneous	-----	48,259
Other minerals [a]	-----	23,945
Total value		$201,923

[a] Includes pumice and salt.

MONTEREY

Land area: 3330 square miles.
Population: 53,668 (1930 census).
Location: West-central portion of state, bordering on Pacific Ocean.
County seat: Salinas.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXI (Jan., 1925).

Monterey County produced 10 different mineral substances during 1931, having a total value of $223,470, as compared with the 1930 output worth $452,974. Its mineral resources include brick, clay, copper, coal, diatomaceous earth, dolomite, feldspar, fuller's earth, gold, gypsum, limestone, mineral water, petroleum, quicksilver, glass sand, sandstone, silver, and miscellaneous stone.

In forty-first place, commercial production for 1931 was as follows:

Substance	*Value*
Gold	$148
Sandstone (Monterey shale)	26,480
Stone, miscellaneous	155,098
Other minerals [a]	141,744
Total value	$223,470

[a] Includes clay (pottery), coal, dolomite, salt, silica (glass sand).

NAPA

Land area: 783 square miles.
Population: 22,832 (1930 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties.'
County seat: Napa.
References: State Mineralogist Report XIV: XVII: XVIII: XX: XXV (April, 1929).

Napa, because of its production of structural and industrial materials and mineral water, stands thirty-fourth on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, magnesite, mineral water, quicksilver, silver, sandstone, and miscellaneous stone. This county has been one of the important producers of quicksilver.

In 1931 the value of the output was $396,841, as compared with the 1930 output, worth $532,983.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Copper	1,945 lbs.	$177
Gold	------	14,766
Mineral water	106,062 gals.	49,665
Quicksilver	1,937 flasks	168,710
Silver	60,009 fine oz.	17,403
Stone, miscellaneous	------	145,900
Unapportioned	------	200
Total value		$396,841

NEVADA

Land area: 974 square miles.
Population: 10,589 (1930 census).
Location: North of Lake Tahoe, on the eastern border of the state.
County seat: Nevada City.
References: State Mineralogist Report XVI: XVII: XVIII: XIX: XX: XXVI (April, 1930).

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921, also 1923. In 1922, 1924, 1929 to 1931, Nevada led all counties in gold output, but it held third place in 1925 and 1928, and second place in 1926 and 1927. Nevada County stands eighth on the list of counties in regard to value of its total mineral output for 1931, with a production worth $3,497,218, the increase being due to gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, chromite, clay, copper, gems, iron, lead, mineral paint, pyrites, soapstone, and tungsten.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Copper	143,984 lbs.	$13,103
Gold	------	3,304,815
Lead	198,671 lbs.	7,351
Silver	150,384 fine oz.	43,611
Stone, miscellaneous	------	123,024
Zinc	149,865 lbs.	5,314
Total value		$3,497,218

ORANGE

Land area: 795 square miles.
Population: 118,611 (1930 census).
Location: Southwestern portion of state, bordering Pacific Ocean.
County seat: Santa Ana.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXI (Jan., 1925).

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral-producing section. It stood for many years, however, as the second county in the state in regard to the total value of mineral output, on account of its highly productive oil fields. It was passed in 1922 by Los Angeles, the credit for which is also due to oil, and in turn Orange passed Kern County in 1923, but dropped back to third in 1924–1928, and dropped to fourth place in 1929 and 1930, being passed by Ventura County, and fifth place in 1931, being passed by Kings.

This county showed a mineral production for 1931 of $15,135,148, compared with the 1930 output worth $26,335,290, the decrease being due to petroleum.

Orange passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, silver, tourmaline and zinc have been found in Orange County.

Commercial production for 1931 was as follows:

Substance	*Amount*		*Value*
Clay (pottery)	21,900	tons	$28,430
Natural gas	14,547,404	M cu. ft.	1,494,855
Petroleum	17,524,067	bbls.	13,231,012
Stone, miscellaneous	---		275,367
Other minerals [a]	---		105,494
Total value			$15,135,148

[a] Includes brick and mineral water.

PLACER

Land area: 1395 square miles.
Population: 24,442 (1930 census).
Location: Eastern border of state directly west of Lake Tahoe.
County seat: Auburn.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XX: XXIII (July, 1927).

While standing only thirty-seventh on the list of mineral-producing counties, Placer contains a wide variety of mineral substances, some of which have not been commercially exploited. Its leading products include gold, chromite, granite, copper, and clay. Other mineral resources are asbestos, brick, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass sand, silver and miscellaneous stone.

Commercial production for 1931 was as follows, compared to a total value of $323,717 for the previous year:

Substance	Amount	Value
Clay (pottery)	78,501 tons	$122,515
Gold	-----	72,409
Granite	-----	6,300
Silver	935 fine oz.	271
Stone, miscellaneous	-----	55,666
Other minerals [a]	-----	28,687
Total value		$285,848

[a] Includes brick and hollow building tile, chromite, copper, mineral paint, mineral water, silica (quartz).

PLUMAS

Land area: 2594 square miles.
Population: 7909 (1930 census).
Location: Northeastern border of state, south of Lassen County.
County seat: Quincy.
References: State Mineralogist Report XVI: XVII: XVIII: XIX: XX: XXIV (Oct., 1928).

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Mineral production for 1931 was valued at $1,559,267 compared with $3,219,900 in 1930. The decrease was due to copper. This placed the county sixteenth in rank. In 1919 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down, which position Plumas still retains.

Among its mineral resources are chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdenum, platinum, silver, and zinc.

Commercial production for 1931 was as follows:

Substance	Amount	Value
Copper	12,473,960 lbs.	$1,135,130
Gold	------	308,443
Silver	322,317 fine oz.	93,472
Stone, miscellaneous	------	20,250
Other minerals [a]	------	2,001
Total value		$1,559,296

[a] Includes granite and lead.

RIVERSIDE

Land area: 7240 square miles.
Population: 82,078 (1930 census).
Location: Southern portion of state.
County seat: Riverside.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXV (Oct., 1929).

Riverside is the fourth county in the state in size and the ninth in regard to the total value of mineral output for 1931. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials, and salines, some of the more important being brick, clay, coal, copper, feldspar, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, soapstone, silver, miscellaneous stone, and tin. In point of variety, Riverside County showed sixteen different minerals commercially produced in 1931. The decrease

in 1931 from the 1930 output, valued at $3,220,636 was due to cement, clay and brick.

Commercial production for 1931 was as follows:

Substance	Amount	Value
Clay (pottery)	56,341 tons	$79,968
Copper	401 lbs.	36
Gold	----	2,524
Lead	1,939 lbs.	72
Silver	44 fine oz.	13
Stone, miscellaneous	----	248,623
Other minerals [a]	----	2,195,267
Total value		$2,526,503

[a] Includes brick and hollow building tile, cement, feldspar, gems (Icelandspar), granite, gypsum, mineral water, silica (quartz and glass sand).

SACRAMENTO

Land area: 983 square miles.
Population: 141,915 (1930 census).
Location: North-central portion of state.
County seat: Sacramento.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXI (Jan., 1925).

Sacramento stands eleventh among the counties of the state as a mineral producer, the output, principally gold, for 1931 being valued at $2,259,674, as compared with the 1930 production worth $2,303,108. In regard to gold output alone, this county ranks second, being exceeded only by Nevada, the Sacramento product coming from the dredges. Its mineral resources include brick, clay, gold, granite, natural gas, platinum, silver and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	Amount	Value
Brick and hollow building tile	----	$151,539
Gold	----	1,871,195
Granite	----	12,316
Platinum	144 oz.	5,876
Silver	3,641 fine oz.	1,056
Stone, miscellaneous	----	205,347
Other minerals [a]	----	12,345
Total value		$2,259,674

[a] Includes pottery clay, lead, natural gas.

SAN BENITO

Land area: 1392 square miles.
Population: 11,310 (1930 census).
Location: West-central portion of state.
County seat: Hollister.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXII (April, 1926).

While twenty-sixth among the counties of the state in regard to value of total mineral production for 1931, San Benito has led for some years in one important branch of the mineral industry, namely, quicksilver.

Its other mineral resources, many of them undeveloped, include antimony, asbestos, bituminous rock, cement, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	Amount	Value
Quicksilver	4,120 flasks	$349,619
Other minerals [a]	----	304,665
Total value		$654,284

[a] Includes bentonite, gems (bentonite), lime, limestone, miscellaneous stone.

SAN BERNARDINO

Land area: 20,157 square miles.
Population: 133,827 (1930 census).
Location: Southeastern portion of state.
County seat: San Bernardino.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXVI (July, 1930): XXVII (July, 1931).

San Bernardino, by far the largest county in the state in area, ranks seventh as regards the value of its mineral output for 1931, with a total of $9,975,484, as compared with the 1930 total of $10,657,301. The decrease is mainly due to cement.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1931 a total of 26 different substances. This county also ranks fourth as a silver producer in the state, from the mines of the Randsburg district.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash salt, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1931 was as follows:

Substance	Amount	Value
Bentonite	3,035 tons	$29,703
Clay (pottery)	1,220 tons	5,333
Copper	6,072 lbs.	553
Gold	------	54,699
Lead	15,763 lbs.	585
Limestone	15,128 tons	56,608
Silver	111,908 fine oz.	32,453
Stone, miscellaneous	------	496,246
Other minerals [a]	------	9,299,304
Total value		$9,975,484

[a] Includes barytes, borax, brick, calcium chloride, cement, gems, lime, manganese, mineral water, potash, pumice, iron ore (hematite), salt, silica (quartz), soda, talc, tungsten.

SAN DIEGO

Land area: 4221 square miles.
Population: 209,477 (1930 census).
Location: Extreme southwest corner of state.
County seat: San Diego.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXI (July, 1925).

San Diego ranks twenty-first in the total value of its mineral output for the year, with 17 different commercial minerals. The value

for 1931 equaled $852,447, as compared with the 1930 output worth $1,303,047.

In the production of semiprecious gems, San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	-----	$79,633
Bentonite	6,416 tons	69,010
Clay (pottery)	11,421 tons	15,487
Feldspar	4,165 tons	54,620
Gold	-----	3,988
Granite	-----	10,192
Silver	51 fine oz.	15
Stone, miscellaneous	-----	411,004
Other minerals [a]	-----	208,507
Total value		$852,447

[a] Includes bromine, gems (emeralite, indicolite, beryl, tourmaline), magnesium chloride, mineral water, salt, silica (quartz), tube-mill pebbles, paving blocks.

SAN FRANCISCO

Land area: 46½ square miles.
Population: 637,212 (1930 census).
County seat: San Francisco.
References: State Mineralogist Report XVII: XVIII: XX: XXV (April, 1929).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting mainly of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In fifty-fifth place, commercial production for 1931 was as follows:

Substance	*Value*
Mineral output [a]	$20,500

[a] Includes miscellaneous stone and mineral water.

SAN JOAQUIN

Land area: 1448 square miles.
Population: 102,871 (1930 census).
Location: Central portion of state.
County seat: Stockton.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (April, 1925).

San Joaquin County reported a mineral production for the year 1931 having a total value of $462,196 as compared with the 1930 output worth $724,862.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In thirty-first place, commercial production for 1931 was as follows:

Substance	*Value*
Brick and hollow building tile	$308,217
Stone, miscellaneous	119,729
Unapportioned	34,250
Total value	$462,196

SAN LUIS OBISPO

Land area: 3334 square miles.
Population: 29,617 (1930).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.
County seat: San Luis Obispo.
References: State Mineralogist Report XV: XVII: XVIII: XXI (Oct., 1925).

The total value of the mineral production of San Luis Obispo County in 1931 was $400,135, as compared with the 1930 output, worth $248,115.

Among its mineral resources, both developed and undeveloped, are asphalt, bituminous rock, brick, chromite, coal, copper, diatomaceous earth, gypsum, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda and miscellaneous stone.

In thirty-third place, commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$1,549
Petroleum	53,349 bbls.	29,342
Quicksilver	2,574 flasks	202,870
Silver	2 fine oz.	1
Stone, miscellaneous	-----	150,016
Other minerals [a]	-----	16,357
Total value		$400,135

[a] Includes brick and hollow building tile, granite (tuff), mineral water, volcanic ash, sandstone (Monterey shale).

SAN MATEO

Land area: 447 square miles.
Population: 77,338 (1930 census).
Location: Peninsula, adjoined by San Francisco on the north.
County seat: Redwood City.
References: State Mineralogist Report XVII: XVIII: XXV (April 1929).

San Mateo's most important mineral products are cement, stone and salt, the last named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1931 equaled $2,230,509, as compared with the 1930 figures of $2,499,937, the decrease being due to cement.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below. Bricks have also been produced commercially.

In thirteenth place, commercial production for 1931 was as follows:

Substance	*Value*
Stone, miscellaneous	$219,715
Other minerals [a]	2,010,794
Total value	$2,230,509

[a] Includes cement, limestone (shells), magnesium salts, natural gas, salt.

SANTA BARBARA

Land area: 2740 square miles.
Population: 65,075 (1930 census).
Location: Southwestern portion of state, adjoining San Luis Obispo on the south.
County seat: Santa Barbara.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXI (Oct., 1925).

Santa Barbara owes its position of sixth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1931 was $12,714,760 as compared with the 1929 output of $24,368,379 and included fifteen different mineral substances. The decrease was due to petroleum and natural gas.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1931 was as follows:

Substance	*Amount*		*Value*
Copper	7,135	lbs.	$650
Gold	----		81
Natural gas	6,534,435	M cu. ft.	446,885
Petroleum	11,660,456	bbls.	11,121,743
Silver	6	fine oz.	2
Stone, miscellaneous	----		67,476
Other minerals [a]	----		1,077,923
Total value			$12,714,760

[a] Includes barytes, bituminous rock, brick and hollow building tile, pottery clay, diatomite, marble, mineral water, quicksilver.

SANTA CLARA

Land area: 1328 square miles.
Population: 144,921 (1930 census).
Location: West-central portion of state.
County seat: San José.
References: State Mineralogist Report XVII: XVIII: XX: XXVI (Jan., 1930).

Santa Clara County reported a mineral output for 1931 of $666,300 as compared with the 1930 figures of $884,329.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone.

In twenty-fourth place, commercial production for 1931 was as follows:

Substance	*Amount*		*Value*
Brick and hollow building tile	----		$82,127
Clay (pottery)	2,665	tons	1,826
Stone, miscellaneous	----		403,453
Other minerals [a]	----		178,894
Total value			$666,300

[a] Includes limestone (shells), magnesite, mineral water, natural gas, petroleum, quicksilver.

SANTA CRUZ

Land area: 435 square miles.
Population: 37,405 (1930 census).
Location: Bordering Pacific Ocean, just south of San Mateo County.
County seat: Santa Cruz.
References: State Mineralogist Report XVII: XVIII: XXII (Jan. 1926).

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $1,767,134, giving the county a standing of fifteenth among all others in the state in this regard. This is a decrease from the 1930 figure of $2,361,954.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Limestone	9,383 tons	$34,430
Stone, miscellaneous	----	98,881
Other minerals [a]	----	1,633,823
Total value		$1,767,134

[a] Includes bituminous rock, cement, coal, lime.

SHASTA

Land area: 3858 square miles.
Population: 13,925 (1930 census).
Location: North-central portion of state.
County seat: Redding.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XXII (April, 1926).

Shasta County stood twenty-fifth in California among the mineral producing counties for 1931, with an output valued at $666,086, as compared with the 1930 production worth $1,111,146.

The marked decrease since 1918 is due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin, but in 1919–1923 was passed by San Bernardino, Plumas, Yuba, Inyo, Sacramento, Nevada, and Amador, among the 'metal' counties, though by only San Bernardino and Plumas of that group in 1925.

Shasta's mineral resources include asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, malybdenum, pyrites, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Copper	309,314 lbs.	$28,148
Gold	------	331,165
Silver	9,712 fine oz.	2,816
Stone, miscellaneous	------	154,163
Other minerals [a]	------	149,794
Total value		$666,086

[a] Includes barytes, granite, lead, platinum, pyrite.

SIERRA

Land area: 923 square miles.
Population: 2419 (1930 census).
Location: Eastern border of state just north of Nevada County.
County seat: Downieville.
References: State Mineralogist Report XVI: XVII: XVIII: XX: XXV (April, 1929).

Sierra County reported a mineral production of $691,365 mainly of gold, during the year 1931, as compared with the 1930 output worth $606,585. Considering gold output this county stands fifth; and as to total mineral yield twenty-third.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, serpentine, and talc.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	----	$651,754
Silver	5,728 fine oz.	1,661
Stone, miscellaneous	----	37,750
Total value		$691,365

SISKIYOU

Land area: 6256 square miles.
Population: 25,505 (1930 census).
Location: Extreme north-central portion of state, next to Oregon boundary.
County seat: Yreka.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXI (Oct., 1925): XXVIII (Jan., 1931).

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks forty-sixth in regard to the value of its mineral output for 1931.

Although this county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the county is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable extent.

Mount Shasta is located in Siskiyou County.

Among Siskiyou's mineral resources are chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	---	$74,326
Silver	583 fine oz.	169
Stone, miscellaneous	---	79,772
Other minerals	---	32,740
Total value		$187,007

SOLANO

Land area: 822 square miles.
Population: 40,807 (1930 census).
Location: Touching San Francisco Bay on the northeast.
County seat: Fairfield.
References: State Mineralogist Report XIV: XVII: XVIII: XXIII (April, 1927).

Solano, while mostly valley land, produced mineral substances during the year 1931 to the total value of $62,270, ranking fiftieth among the counties of the state, an increase from the 1930 figure of $46,638.

Among her mineral resources are brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	*Value*
Unapportioned [a]	$62,270

[a] Includes onyx and travertine, miscellaneous stone.

SONOMA

Land area: 1577 square miles.
Population: 62,248 (1930 census).
Location: South of Mendocino County, bordering on the Pacific Ocean.
County seat: Santa Rosa.
References: State Mineralogist Report XIV: XVII: XVIII: XXII (July, 1926).

Sonoma ranked fortieth among the counties of California during the year 1931, with a mineral production of $252,636, as compared with its 1930 output of $330,399. More paving blocks have been turned out here than in any other section of the state, but this industry has now ceased, owing to the construction of smooth-surface pavements, both in the cities and on the highways.

Among Sonoma's mineral resources are brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Mineral water	44,576 gals.	$8,227
Quicksilver	449 flasks	39,392
Stone, miscellaneous	-----	204,702
Unapportioned	-----	315
Total value		$252,636

STANISLAUS

Land area: 1450 square miles.
Population: 56,624 (1930 census).
Location: Center of state, bounded on south by Merced County.
County seat: Modesto.
References: State Mineralogist Report XIV: XVII: XVIII: XXI (April, 1925).

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921–1923 and

1925–1930 by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1931 ranks thirty-ninth in the state in regard to value of minerals, with an output of $277,281, as compared with $331,688 in 1930. Gold, platinum and silver are obtained mainly by dredging.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	---	$154,443
Silver	768 fine oz.	223
Stone, miscellaneous	---	87,596
Other minerals [a]	---	35,019
Total value		$277,281

[a] Includes pottery, clay, magnesite, platinum.

SUTTER

Land area: 608 square miles.
Population: 14,618 (1930 census).
Location: Bounded by Butte County on the north and Sacramento on the south.
County seat: Yuba City.
References: State Mineralogist Report XV: XVII: XVIII.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, also in 1925–1928.

There has been some utilization of natural gas. There was no mineral production reported in 1931. Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA

Land area: 2893 square miles.
Population: 13,839 (1930 census).
Location: North-central portion of the state, bounded on the north by Shasta.
County seat: Red Bluff.
References: State Mineralogist Report XV: XVII: XVIII: XIX: XXIV (July, 1928).

Tehama stands fifty-first among the mineral producing counties of the state for 1931, when its output was valued at $50,407 as compared with the 1930 yield, worth $226,400.

Among its mineral resources are listed brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1931 yield was distributed as follows:

Substance	*Value*
Stone, miscellaneous	$49,407
Unapportioned	1,000
Total value	$50,407

TRINITY

Land area: 3166 square miles.
Population: 2811 (1930 census).
Location: Northwestern portion of state.
County seat: Weaverville.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXII (Jan., 1926).

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver and platinum, very little active production of these mineral substances has been made as yet.

The 1931 output of $328,522 shows a decrease from the 1930 figure of $437,333, due to gold and copper, giving the county rank of thirty-sixth for the year.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	----	$292,031
Platinum	31 oz.	993
Silver	1,835 fine oz.	532
Stone, miscellaneous	----	20,246
Other minerals [a]	----	14,720
Total value		$328,522

[a] Includes coal and quicksilver.

TULARE

Land area: 4856 square miles.
Population: 77,375 (1930 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.
County seat: Visalia.
References: State Mineralogist Report XV: XVII: XVIII: XX.

Tulare stands forty-fourth on the list of mineral-producing counties, the decrease from the 1930 value being due mainly to granite and miscellaneous stone.

This county's mineral resources, among others, are brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, except in 1918, when it was passed by Napa County, and since 1921 by Santa Clara.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	--	$244
Silver	6 fine oz.	2
Stone, miscellaneous	--	75,778
Other minerals [a]	--	121,092
Total value		$197,116

[a] Includes barytes, brick and hollow building tile, gems, granite, limestone, magnesite, petroleum.

TUOLUMNE

Land area: 2190 square miles.
Population: 9239 (1930 census).
Location: East-central portion of state—Mother Lode District.
County seat: Sonora.
References: State Mineralogist Report XIV: XVII: XVIII: XIX: XX: XXIV (Jan., 1928).

Tuolumne ranks thirty-fifth among counties of the state relative to its total value of mineral output for 1931. This county ranks first as a producer of marble in the state. The mineral production for 1931 was valued at $377,157 compared with $318,322 in 1930.

Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Gold	--	$77,902
Silver	622 fine oz.	180
Stone, miscellaneous	--	100,785
Other minerals [a]	--	198,290
Total value		$377,157

[a] Includes chromite, copper, lime, limestone, marble, slate, soapstone.

VENTURA

Land area: 1878 square miles.
Population: 54,577 (1930 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.
County seat: Ventura.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXI (April, 1925).

Ventura is fourth county in the state in respect to the value of its mineral output for 1931. Its value passed that of Orange County, which for many years held this position. The 1931 mineral production was worth $15,455,727 as compared with the 1930 output worth $31,952,052, the decrease being due to petroleum and natural gas.

Commercial production for 1931 was as follows:

Substance	*Amount*	*Value*
Clay (pottery and oil well drilling)	61,300 tons	$17,418
Gold	----------	293
Natural gas	53,643,509 M cu. ft.	1,875,264
Petroleum	17,245,113 bbls.	13,297,707
Silver	9 fine oz.	3
Stone, miscellaneous	----------	184,483
Other minerals [a]	----------	80,559
Total value		$15,455,727

[a] Includes brick and hollow building tile, granite (flagstone), limestone (marl).

YOLO

Land area: 1017 square miles.
Population: 23,618 (1930 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.
County seat: Woodland.
References: State Mineralogist Report XIV: XVII: XVIII.

The mineral production from Yolo County during the year 1931 consisted entirely of miscellaneous stone, valued at $21,500, ranking it in fifty-fourth place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA

Land area: 639 square miles.
Population: 11,327 (1930 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas.
County seat: Marysville.
References: State Mineralogist Report XV: XVII: XVIII: XX: XXVI (July, 1930).

Yuba is twentieth of the mineral producing counties of the state, and has been first as a gold producer from 1925–1928, but was passed by Nevada, Amador, and Sacramento counties in the output of that metal in 1929. Iron and clay deposits have been reported in this county aside from the following commercial production shown for the year 1931. The increase over the 1930 figure of $1,018,399 was due mainly to gold obtained by the dredgers (which also yield silver), to platinum and miscellaneous stone. The 1921 dredge yield of gold was a record for the county.

The 1931 production of Yuba County was distributed as follows:

Substance	*Amount*	*Value*
Gold	----	$991,976
Silver	3,345 fine oz.	970
Other minerals [a]	----	29,880
Total value		$1,022,826

[a] Includes platinum and miscellaneous stone.

CHAPTER VIII

DIRECTORY OF PRODUCERS OF METALLIC AND NON-METALLIC MINERALS IN CALIFORNIA, 1931

Note—The producers of natural gas and petroleum will be found in the Quarterly Summary of Operations, California Oil Fields, for July, August and September, 1931 (Vol. 17, No. 1).

BARYTES

Operator	Product	Address	Location of mine
Inyo County			
Crucible Mining & Development Co.		P. O. Box T-1, Ventura	Laws
Mariposa County			
National Pigments Co.		Russ Bldg., San Francisco	El Portal
San Bernardino County			
Mineral Milling Co.		1081 Richmond st., Los Angeles	
Santa Barbara County			
Baronite Co.		524 Avalon Blvd., Wilmington	La Brea
Shasta County			
Austin Barite Mine, Chemical & Pigment Co., Inc.		766 50th Ave., Oakland	Castella
Tulare County			
Paso-Baryta Mine, Ltd., R. A. Fredricks		619 17th St., Merced	Olancha

BENTONITE (FULLER'S EARTH)

Operator	Product	Address	Location of mine
Inyo County			
California Desert Products Co.		58 Sutter St., San Francisco	Death Valley Jct.
Kern County			
The Filtrol Co.		1755 Downey Rd., Los Angeles	Monolith
Muroc Clay Co.		5525 Randolph St., Maywood	Muroc
Los Angeles County			
The Filtrol Co.		1755 Downey Rd., Los Angeles	
San Benito County			
D. L. Stewart Property, A. P. Stewart, Lessee		1052 Vermont St., San Jose	Tres Pinos

Operator	Product	Address	Location of mine
San Bernardino County			
Walter Becker		P. O. Box 374, Red Mountain	Red Mountain
California Talc Co.		837 Jackson St., Los Angeles	Hector
Hill Bros. Chemical Co.		2159 Bay St., Los Angeles	Barstow
Mineral Milling Co.		1061 Richmond St., Los Angeles	
J. H. Stone		Barstow	Barstow
J. Von Gal-Scale		512 S. Bixel St., Los Angeles	
J. W. Wood		247 Eureka Ave., San Bernardino	Barstow
San Diego County			
Mosto Otaylite Deposit, General Petroleum Corp. of Cal.		1003 Higgins Bldg., Los Angeles	Otay
Standard Oil Co. of California		Standard Oil Bldg., San Francisco	Palm Siding

BITUMINOUS ROCK

Operator	Product	Address	Location of mine
Santa Barbara County			
Higgins Quarry, D. A. Sattler, lessee		856 Arguello Rd., Santa Barbara	Carpinteria
Santa Cruz County			
Calrock Asphalt Co.		525 Market St., San Francisco	Majors

BORATES

Operator	Product	Address	Location of mine
Inyo County			
Pacific Alkali Co.		1209 Pacific Mutual Bldg., Los Angeles	Bartlett
Kern County			
Pacific Coast Borax Co.		1014 Central Bldg., Los Angeles	Kramer
Suckow Borax Mines Consolidated, Inc., John K. Suckow		1283 Third Ave., Los Angeles	Muroc
Western Borax Co.		P. O. Box 37, Muroc	Muroc
San Bernardino County			
American Potash and Chemical Corp.		Trona	Trona
West End Chemical Co.		Syndicate Bldg., Oakland	Searles Lake

BROMINE

Operator	Product	Address	Location of mine
Alameda County			
California Chemical Corp.		Box 8-A, Newark	Newark
San Diego County			
California Chemical Corp.		Box 8-A, Newark	San Diego

CALCIUM CHLORIDE

Operator	Product	Address	Location of mine
San Bernardino County			
California Rock Salt Co.		2465 Hunter St., Los Angeles	Amboy
Saline Products, Inc.		2000 Santa Fe Ave., Los Angeles	Amboy

CEMENT

Operator	Product	Address	Location of mine
Calaveras County			
Calaveras Cement Co.		315 Montgomery St., San Francisco	San Andreas
Contra Costa County			
Henry Cowell Lime and Cement Co.		2 Market St., San Francisco	Cowell
Kern County			
Monolith Portland Cement Co.		Bartlett Bldg., Los Angeles	Monolith
Los Angeles County			
Blue Diamond Corp.		1650 S. Alameda St., Los Angeles	Los Angeles

Merced County			
Yosemite Portland Cement Co.		Merced	Merced
Riverside County			
Riverside Cement Co.		621 S. Hope St., Los Angeles	Riverside
San Bernardino County			
California Portland Cement Co.		1228 Pacific Mutual Bldg., Los Angeles	Colton
Southwestern Portland Cement Co.		503 Roosevelt Bldg., Los Angeles	Victorville
San Mateo County			
Pacific Portland Cement Co.		111 Sutter St., San Francisco	Redwood City
Santa Cruz County			
Santa Cruz Portland Cement Co.		Crocker Bldg., San Francisco	Davenport

CHROMITE

Operator	Remarks	Address	Location of mine
El Dorado County			
U. S. Chrome Mines, Inc.	s	Box 218, Reno, Nev.	Folsom
Fresno County			
N. H. Joyner	s	2410 Clay St., San Francisco	Coalinga
Placer County			
Harry McCormack	s	Alta	Alta
Daniel Sullivan	o	Towle	Dutch Flat
J. L. Williams	s	807 Broadway, Oakland	Forest Hill
San Luis Obispo County			
P. A. H. Arata, Pick and Shovel Mine	o	San Luis Obispo	Goldtree
Shasta County			
Antone Orsini	o	Box 170, Redding	
Tuolumne County			
McCormick Chrome Mine, Robert McCormick	s	Jamestown	Jamestown

o. Mined, but made no shipments. s. Both mined and shipped ore.

CLAY

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

Operator	Remarks	Address	Location of mine
Alameda County			
California Faience Co.	a	1335 Hearst Ave., Berkeley	Berkeley
N. Clark & Sons	a, b, c	116 Natomas St., San Francisco	Oakland
Livermore Fire Brick Work and California Brick Plant, W. S. Dickey Clay Mfg. Co.	a, b, c	Rialto Bldg., San Francisco	Livermore and Fabrico
Electrical Porcelain Works	a	2416 6th St., Berkley	Berkeley
Interlocking Tile Co.	a, c	Niles	Niles
Kraftile Co., L. J. Layton	a	Niles	Niles
M. & S. Tile Co., Geo. A. Smith and J. M. Muneze	a, c	Decoto	Decoto
McNeal Clay Mine, C. B. Mally	c	Livermore	Tesla
Muresque Tiles, Inc.	a	503 Merchants Exchange Bldg., San Francisco	Oakland
Remillard Brick Co., R. C. Giroux, Secy.	b	569 3d St., Oakland	Pleasanton
Technical Porcelain and China Ware Co.	a	420 Kains Ave., Albany, via Berkeley, Cal.	Albany
Thomas Handmade Roofing Tile Co.	a, c	Decoto	Decoto
Western Clay Products	a, c	400 11th St., San Francisco	Niles
Emeryville Porcelain Works, Westinghouse Elec. and Mfg. Co.	a	East Pittsburgh, Pa.	Emeryville
Walrich Pottery	a	1285 Hearst Ave., Berkeley	Berkeley
Woolenius Tiles and Mantels	a	1315 2d St., Berkeley	Berkeley
Amador County			
M. J. Bacon	c	Ione	Carbondale
Carlyle Clay Deposits, E. E. Tremain	c	Buena Vista, via R. F. D., Ione	Buena Vista
N. Clark & Sons	c	116 Natoma St., San Francisco	Ione
Ione Clay Pit, W. S. Dickey Clay Mfg. Co.	c	Rialto Bldg., San Francisco	Ione
Ione Fire Brick Co., J. T. Roberts, Mgr.	b	1267 Russ Bldg., San Francisco	Ione
Ione Clay and Sand Co., Cal. Mineral Products Co.	c. f	Kohl Bldg., San Francisco	Ione
Newman Clay Co., C. W. Forbes, lessee	c	Ione	Ione
Preston School of Industry	b	Ione	Ione
Butte County			
Lund Clay Plant, Nelson Lund	b	Oroville	Palermo
Contra Costa County			
California Art Tile Co., J. W. Hislop, Mgr.	a	Box 1116, Richmond	Richmond
Clark Shale Deposit, N. Clark & Sons	c	116 Natoma St., San Francisco	Walnut Creek
Old Mission Tile Co.	a, c	1 20th St., Richmond	San Pablo

Port Costa Brick Works, C. G. Berg, Pres.	b	6th and Berry Sts., San Francisco	Port Costa
Silica Sand Mine, Thomas G. Roberts	c	Pittsburg	Nortonville
Standard Sanitary Mfg. Co., H. W. Creeger, Mgr.	a	Box I, Richmond	Richmond
United Materials & Richmond Brick Co., Ltd.	a, b, c	P.O. Box 7, Richmond	Richmond
Western Potters, Ltd.	a	136 Kearny St., El Cerrito	El Cerrito
Fresno County			
Craycroft Brick Co.	b	Griffith-McKenzie Bldg., Fresno	Fresno
Humboldt County			
J. D. Thompson Brick Co., J. D. Thompson, Mgr.	a, b, c	Box 16, Myrtle Ave., Eureka	Eureka
Inyo County			
California Desert Products Co.	e	58 Sutter St., San Francisco	Death Valley
Kern County			
Bakersfield Sandstone Brick Co., Jas. Curran, Mgr.	b	Bakersfield	Bakersfield
The Filtrol Co.	e	1755 Downey Rd., Los Angeles	Monolith
King Lumber Co.	b	1402 King St., Bakersfield	Bakersfield
Muroc Clay Co.	e	5525 Randolph St., Maywood, Cal.	Muroc
Mojave Rotary Mud Co., Ltd.	d	Box 174, Los Nietos	Muroc
Owl Truck Co.	d	120 N. Tamarind, Compton	
Vitrefrax Co.	c	5050 Pacific Blvd., Los Angeles	Cantil
Los Angeles County			
Alhambra Brick & Tile Co.	b	5547 Valley Blvd., Los Angeles	Los Angeles
Alhambra Kilns, Inc., W. Boswell	a	Alhambra	Alhambra and Santa Monica
American Refractories Co.	a, b	3232 Alosta St., Los Angeles	Los Angeles
Angulo Tile Plant, R. F. Angulo & Sons	a, c	Reseda	Reseda
Art Tile Co.	a	2304 E. 52d St., Los Angeles	Vernon
Batchelder-Wilson Tile Co.	a	2633 Artesian St., Los Angeles	Los Angeles
J. A. Bauer Pottery Co.	a	415 W. Ave. 33, Los Angeles	Los Angeles
Bay Cities Roofing Co., Inc.	a, c	1724 Stanford St., Santa Monica	Santa Monica
J. Booth	a	7578 Melrose, Los Angeles	Santa Monica
Builders Brick Co., Ltd.	b	177th and Western Aves., Moneta	Moneta
Calco Tile Mfg. Corp.	a	South Gate	South Gate
California Clay Prod. Co., Ltd.	a, c	Box 568, Whittier	Whittier
Claycroft Potteries, Fred H. Robertson	a	3101 San Fernando Blvd., Los Angeles	Los Angeles
Compton Brick and Tile Co.	b	402 Pacific S.W. Bldg., Long Beach	Compton
Consolidated Brick & Tile Co., Ltd.	a, b, c	306 Architect Bldg., Los Angeles	Los Angeles, Long Beach and Santa Monica
Cooks Co., H. F., Inc.	a	Inglewood	Inglewood

a. Clay products. b. Brick and hollow building tile. c. Crude clay. d. Oil well drilling mud. e. Filtering clay. f. Fire sand. h. Earth.

CLAY—Continued

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

Operator	Remarks	Address	Location of mine
Los Angeles County—Continued			
Davidson Brick Co.	b	4701 Floral Dr., Los Angeles	Los Angeles
Eljer California Co.	a	4100 Alameda, Los Angeles	Arcadia
Empire China Co.	a	Burbank	Burbank
Emsco Refractories Co.	b	8661 Dorothy Ave., South Gate	South Gate
Tropico, L. A. & S. M. Plants, Gladding, McBean & Co.	a, b, c	660 Market St., San Francisco	Tropico, Los Angeles and Santa Monica
Higgins Brick & Tile Works, James R. Higgins	a, b, c	155 E. 121st St., Los Angeles	Moneta
Hispano-Moresque Tile Co.	a	3d and Rushton Sts., Lawndale	Lawndale
Italian Terra Cotta Co.	a	1149 Mission Rd., Los Angeles	Los Angeles
K. & K. Brick Co., Geo. H. Snyder, Pres.	b	730 C. C. Chapman Bldg., Los Angeles	Bishop Canyon
K. & M. Pottery Co.	a	2318 E. 52d St., Los Angeles	Los Angeles
Long Beach Brick Co., Inc., H. A. Havner, Mgr.	b	154 Elm Ave., Long Beach	Long Beach
Los Angeles Brick Co.	b	1078 Mission Rd., Los Angeles	Los Angeles
Malibu Potteries	a	P.O. Box 518, Santa Monica	Santa Monica
Markoff Mosaic Tile Corp.	a	1107 E. Redondo Blvd., Inglewood	Inglewood
Pacific Clay Products	a, b, c	650 Chamber of Comm. Bldg., Los Angeles	Los Angeles and Los Nietos
Pomona Brick Co., Wm. McMullen, Mgr.	b	Pomona	Pomona
Pomona Tile Mfg. Co.	a	Pomona	Pomona
San Valle Tile Kilns, R. F. Stubver, Mgr.	a, c	6601 Wilbur, Reseda	Reseda
Santa Catalina Island Co., Wm. Wrigley, Jr.	a, b, c	Avalon	Santa Catalina Island
St. Louis Fire Brick and Clay, Joseph Mesmer	a, b	3050 E. Slauson St., Los Angeles	Los Angeles
Simons Brick Co., Walter R. Simons	a, b, c	1195 S. Boyle Ave., Los Angeles	Los Angeles
Standard Brick Co.	b	580 Chamber of Commerce, Los Angeles	Los Angeles
Tillotson Clay Products	a, b	3363 Fruitland Rd., Vernon	Vernon
Torrance Brick Co.	b	Border St., Torrance	Torrance
Tudor Potteries	a	2406 E. 58th St., Los Angeles	Los Angeles
Vernon Potteries	a	2300 E. 52d St., Los Angeles	Vernon
Vitrefrax Company	a, b	5100 Pacific Ave., Los Angeles	Vernon
West Coast Tile Manufacturers	a, c	3515 W. Pico St., Los Angeles	Huntington Park
Western Standard Tiling Co.	a	1461 Lincoln St., Hollydale	Hollydale
Marin County			
McNear Brick Co.	b	McNear Point, San Rafael	McNear
Monterey County			
Castroville Clay Prod. Co.	a, c	Castroville	Castroville

Orange County			
American Fire Clay Co.	c	5050 Pacific Blvd., Vernon	San Juan
Gladding, McBean & Co.	c	660 Market St., San Francisco	
La Bolsa Tile Co., A. N. Griffith	a, b, c	Rt. 1, Box 174, Huntington Beach	Smeltzer
Mission Clay Products Co.	a, b, c	Olive	Olive
Placer County			
Clay Corp. of Cal.	c	1267 Russ Bldg., San Francisco	Lincoln
Gladding, McBean & Co.	a, b, c	5th floor, 660 Market St., San Francisco	Lincoln
Lincoln Clay Products Co., M. J. Dillman, Mgr.	c	Lincoln	Lincoln
Riverside County			
Alberhill Coal and Clay Co.	c	Alberhill	Alberhill
Emsco Clay Co.	c	5701 S. Boyle Ave., Vernon	Corona
Gladding, McBean & Co.	a, b, c	660 Market St., San Francisco	Alberhill
Los Angeles Brick Co.	a, b, c	1078 Mission Rd., Los Angeles	Alberhill
Geo. H. Morton	c	Elsinore	Elsinore
Pacific Clay Products	c	650 Chamber of Commerce Bldg., Los Angeles	Corona
H. Pate	a, c	Corona	Prado
Tarwater & Southard	c	Murrietta	Murrietta
Sacramento County			
Cannon & Co.	a, b, c	Box 281, Sacramento	Ben Ali
H. C. Muddox	a, b	30th and L Sts., Sacramento	Sacramento
Panama Pottery Co.	a	Box 1478, R.F.D. No. 4, 24th St. Rd., Sacramento	Sacramento
Sacramento Brick Co.	b	1400 Front St., Sacramento	Sacramento
Valley Brick Co.	b	P. O. Box 1180, Sacramento	Sacramento
San Benito County			
D. L. Stewart Property, A. P. Stewart, lessee	e	1052 Vermont St., San Jose	Tres Pinos
San Bernardino County			
Becker, Walter	e	P. O. Box 374, Red Mountain	Searle Station
California Talc Co.	c, e	837 Jackson St., Los Angeles	Hector
Hancock Brick Yard, C. P. Hancock & Son	a, b, c	4330 Lemon St., Riverside	Highgrove
Hill Bros. Chemical Co.	e	2159 Bay St., Los Angeles	Barstow
Kennedy Clay Pit, John Kennedy	c	Daggett	Daggett
Mineral Milling Co.	e	1061 Richmond St., Los Angeles	
Standard Sanitary Mfg. Co., Pacific Mines, P. R. Jones	c	Campo	Hart
J. H. Stone	d, e	Barstow	Barstow
J. Von Gal-Scale	e	618 S. Bixel St., Los Angeles	
J. W. Wood	e	247 Eureka Ave., San Bernardino	Barstow

a. Clay Products. b. Brick and hollow building tile. c. Crude clay. d. Oil well drilling mud.

CLAY—Continued

(Including producers of crude clay and manufacturers of brick, tile, porcelain, etc.)

Operator	Remarks	Address	Location of mine
San Diego County			
American Encaustic T. Co.	a	52d and Alameda Sts., Los Angeles	El Cajon
Mosto Otaylite Deposit, General Petroleum Corp.	e	1003 Higgins Bldg., Los Angeles	Otay
Pacific Clay Products Co.	c	650 Chamber of Commerce Bldg., Los Angeles	Farr Station
Standard Oil of California	e	Standard Oil Bldg., San Francisco	Palm Siding
Union Brick Co., J. W. Rice	b	3565 3d St., San Diego	Rose Canyon
Vitrified Products Corp.	a, b, c	2841 Jefferson St., North San Diego	North San Diego
San Francisco County			
Jalanivich & Olsen	a	2930 Baker St., San Francisco	San Francisco
San Joaquin County			
San Joaquin Brick Co., J. F. Stein, Secy.	b	33 S. El Dorado St., Stockton	Stockton
Stockton Brick and Tile Co.	b	McKinley Ave., Stockton	Stockton
Stockton Fire Brick Co., John T. Roberts, Mgr.	b	Stockton	Stockton
Stockton Pottery Co.	a	600 E. Main St., Stockton	Stockton
San Luis Obispo County			
San Luis Brick Works	b	San Luis Obispo	San Luis Obispo
San Mateo County			
Richmond Potterys, Inc.	a	Box 187, South San Francisco	South San Francisco
West Coast Porcelain Co.	a	P. O. Box 46, Millbrae	Millbrae
Santa Barbara County			
Gamble Brick Co. E. T. Gamble	a, b	Santa Maria	Santa Maria
Montecito Clay Products Co.	a, c	2800 E. 9th St., Los Angeles	Carpinteria
Santa Clara County			
Carroll Gravel Pit, R. D. Carroll	c	950 6th St., San Jose	San Jose
Coyote Creek Clay Beds, L. R. Lenfest	c	1195 E. Santa Clara St., San Jose	San Jose
Garden City Pottery, N. J. Mahone	a	560 N. 6th St., San Jose	San Jose
Gladding Bros. Mfg. Co.	a, b	South 3d and Keys Sts., San Jose	San Jose
Handcraft Tile Co., L. W. Austin et al	a	Route 2, Box 121A, San Jose	San Jose
Geo. J. Poxon	a	P. O. Box 327, Santa Clara	Santa Clara

Remillard Brick Co.	b	569 3d St., Oakland	San Jose
San Jose Brick Co.	b	P. O. Box 274, San Jose	San Jose
S. & S. Tile Co.	a	1881 S. 1st St., San Jose	San Jose
Stanislaus County			
Coopertown Clay Deposit, J. H. Hornsby	a	651 Cumberland St., Pittsburg	Coopertown
Tulare County			
San Joaquin Materials Co.	b	744 G St., Fresno	Exeter
Ventura County			
Anderson & Hardison Press Brick Co., J. C. Hardison and G. A. Anderson	b, c	Santa Paula	Santa Paula
Peoples Lumber Co., C. E. Boncstel, Mgr.	b, c	708 E. Meta St., Ventura	Ventura
Dent Clay Pit, Shell Oil Co.	d	Shell Bldg., San Francisco	Ventura

a. Clay products. b. Brick and hollow building tile. c. Crude clay. d. Oil well drilling mud. e. Filtering clay.

COAL

Operator	Remarks	Address	Location of mine
Amador County			
Buena Vista Coal Mining Co., J. J. Morras, Supt.		Ione, c/o R.F.D.	Buena Vista
Monterey County			
Stone Canyon Coal Co., J. A. Chanslor	a	Wells Fargo Bldg., San Francisco	Stone Canyon
Santa Cruz County			
Look Coal Mine, C. R. Look		44 Clay St., Santa Cruz	Corralitos
Trinity County			
Big Bar Coal Mining Co., E. O. E. Klipphahn, Secy.		Route 1, Box 92A, Grass Valley	Big Bar

a. Also operated by the American Coal Co., same address.

COPPER

Principal Copper Producers in California in 1931

Mine	Operator	Address	Location of mine
Nevada County			
Murchie	American Foundation Co.	P. O. Box 687, Nevada City	Nevada City
Spanish	Spanish Mining Co.	Crocker Bldg., San Francisco	Washington
Plumas County			
Walker	Walker Mining Co.	Kearns Bldg., Salt Lake City, Utah	Walkermine
Shasta County			
Hornet	Mountain Copper Co., Ltd., W. S. Howard	112 Market St., San Francisco	Matheson

DIATOMITE (DIATOMACEOUS EARTH)

Operator	Remarks	Address	Location of quarry
Fresno County			
Mineral Products Mfg. Co., T. H. Eliatt and L. J. Allen		3464 Ventura St., Fresno	Mendota
Los Angeles County			
The Dicalite Co.		756 S. Broadway, Los Angeles	San Pedro
Monterey County			
Calatom Co., R. B. Hoffman et al.		Monterey	Monterey
Pacatome, Ltd.		Bradley	Bradley
Santa Barbara County			
Celite Corp.		Lompoc	Lompoc
National Silica Products Co., C. E. Miller		1201 Bryant St., Palo Alto	Lompoc

DOLOMITE

Operator	Remarks	Address	Location of quarry
Inyo County			
Inyo Marble Co.		361 N. Avenue 22, Los Angeles	Lone Pine
Monterey County			
Pacific Coast Steel Corp., Sterling Ranch Dolomite Quarry		Bethlehem, Pa.	Natividad

FELDSPAR

Operator	Remarks	Address	Location of mine
Kern County			
N. W. Sweetser		4235 Monroe St., Los Angeles	Rosamond
Riverside County			
K. & K. Ranch Deposit, Dr. J. Von Gal-Scale		618 S. Bixel St., Los Angeles	San Jacinto
Valmont Vista Mine, James D. Gray		Box 172, Perris	Winchester
San Diego County			
Mineral Milling Co.		1081 Richmond St., Los Angeles	White Oak Springs
Standard Sanitary Mfg. Co., P. R. Jones, Mgr.		Campo	Campo
Dr. J. Von Gal-Scale		618 S. Bixel St., Los Angeles	Jacumba Hotsprings

GEMS

Operator	Variety	Address	Location of mine
Counties, various			
Felker Research Laboratory, Max N. Felker	Rose quartz, blue-agate, myrickite, jasper, bloodstone, chrysoprase, amethyst	3321 Emerald St., Torrance	
Butte County			
———	Diamonds		Cherokee
Calaveras County			
Green Mountain Mine, J. J. McSorley, Mgr.	Quartz crystals	Mokelumne Hill	Mokelumne Hill
Fresno County			
Sierra Gem Mine, C. M. Carter	Topaz	2325 Valley St., Oakland	Friant
Riverside County			
Carniger Mine, H. F. Heather	Iceland-spar	236 S. Oak Knoll Ave., Pasadena	Indio
San Benito County			
Dallas Mining Co., R. W. Dallas	Benitoite	Coalinga	Idria
San Diego County			
J. W. Ware	Emeralite, indicolite, beryl, topaz, tourmaline	1060 6th St., San Diego	Smith Mountain
Tulare County			
A. Skinkle property, A. L. Jamison	Rose quartz, chrysoprase	c/o A. Skinkle, R.F.D. Porterville	Porterville
Janoiko Bros.	Rose quartz, chrysoprase	R.F.D. 1, Box 688, Porterville	Porterville

Principal Gold Producers in California out of a Total of 959 operators[1] of Placer and Lode Mines in 1931

Mine	Type of mine	Operator	Address	Location of mine
Amador County				
Amador Queen No. 2	d	Garibaldi Bros.	Jackson	Jackson
Argonaut	a	Argonaut Mining Co.	Humboldt Bank Bldg., San Francisco	Jackson
Summet and Old Eureka	a	Central Eureka Mg. Co.	Hunter-Dulin Bldg., San Francisco	Sutter Creek
Fuller Property	a	Bornich and Zumwalt	Jackson	Jackson
Kennedy	a	Kennedy Mng. & Mg. Co.	519 California St., San Francisco	Martell
Lancha Plana	e	Lancha Plana Gold Dredging Co.	Comanche	Comanche
Levezzo Ranch	a	P. F. Peterson	Jackson	Jackson
Butte County				
Las Plumas	a	C. W. Erickson	Yankee Hill	Yankee Hill
Thurmon Hill	e	Shasta-Butte Gold Dredging Co.	Oroville	Oroville
Calaveras County				
Black	a	Calaveras Mining & Milling Co.	184 S. 11th St., San Jose	
Calaveras	a	Mar-John Mines Co.	342 5th St., San Francisco	Sheepranch
Calaveras Central	f	Calaveras Central Gold Mg. Corp., Ltd.	Mills Tower, San Francisco	Angels Camp
Gold Gravel	b	Gold-Gravel Products Co., Inc.	Box 113, Berkeley	Wallace
Milton	e	Milton Mining Co.	Turlock	Milton
Royal	a	Western Empire Mines Co., Ltd.	Milton	Milton
El Dorado County				
Great Bend	b	Great Bend Corp.	707 Petroleum Securities Bldg., Los Angeles	Lotus
Kelsey	a	Kelsey Mining Co.	582 Market St., San Francisco	Placerville
Pal-O-Mine	a	Sciaroni Bros.	Grizzly Flats	Grizzly Flats
Poverty Point & Fortuna	a	Golden Horseshoe Mining Corp.	Placerville	Placerville
Pocket Claim	d	George Swift	Georgetown	Georgetown
Slate Mountain	a	R. W. Brooke	Box 222, Placerville	Placerville
Sliger	a	Sliger Gold Mining Co.	3628 Fulton St., San Francisco	Greenwood
Van Hooker	a	Placerville Gold Mng. Co.	Box 512, Placerville	Placerville
Inyo County				
Carbonate	a	Whitman Symmes	51 Shipley St., San Francisco	Zabriskie
Estelle & Cerro Gordo	a	American Smetling & Refining Co.	McCormick Bldg., Salt Lake City, Utah	Keeler
Radcliff	a	W. D. Clair and Sons	208 N. Union Ave., Los Angeles	Trona

[1] Number does not include snipers, prospectors, and various individuals selling small lots to bullion dealers.

GOLD—Continued

Principal Gold Producers in California out of a Total of 959 operators [1] of Placer and Lode Mines in 1931

Mine	Type of mine	Operator	Address	Location of mine
Kern County				
Butte Lode	a	Butte Lode Mining Co.	Roosevelt Bldg., Los Angeles	Randsburg
Hercules	a	Operator Consolidated Mines Co.	Russ Bldg., San Francisco	Johannesburg
King Solomon	a	Shipsey Mining Co.	123 E. 6th St., Los Angeles	Randsburg
Long Tom	a	Long Tom Mining & Milling Co.	Cantil	Cantil
Standard	a	Standard Mining Co.	Bank of America Bldg., San Diego	Mojave
Yellow Aster	a	Yellow Aster Mng. & Mg. Co.	Randsburg	Randsburg
Mariposa County				
Cornet	a	Ernest Brigmardelli	Coulterville	Coulterville
Original & Clearinghouse	a	Original Ferguson Mng. & Mg. Co.	Clearinghouse	Clearinghouse
Virginia	a	Consolidated Metal Mines Co.	Coulterville	Coulterville
Merced County				
Merced Unit	e	Yuba Consl. Gold Field, Hammon Eng. Co.	351 California St., San Francisco	Snelling
Mono County				
Red Cloud	a	Treadwell Yukon Co., Ltd.	Crocker Bldg., San Francisco	Bodie
Napa County				
Palisades	a	Banner Dev. Co., Andrew Rocca, Receiver	Calistoga	Calistoga
Nevada County				
Anchor [2]	a	Gordon M. Bettles	Nevada City	Graniteville
Empire and North Star	a	Empire-Star Mining Co., Ltd.	14 Wall St., New York, N. Y.	Grass Valley
Idaho Maryland	a	Idaho Maryland Mining Co.	Russ Bldg., San Francisco	Grass Valley
Mary-Ellen	a	Consolidated Metal Mines Co.	Nevada City	Nevada City
Montana	a	Hoge Development Co.	509 Pine St., Nevada City	Nevada City
Murchie [2]	a	American Foundation Co.	P. O. Box 687, Nevada City	Nevada City
Omega Hill	g	Omega Hill Mining Co.	35 Cooper Ave., Yuba City	Washington
Spanish	a	Spanish Mining Co.	Crocker Bldg., San Francisco	Washington

Placer County				
Big Oak	a	Parmount Gold Mining Corp., Ltd.	Box 336, Auburn	Butchers Ranch
DeMaria	d	C. J. DeMaria	McKean	McKean
Glenn	f	S. Janas	57 Post St., San Francisco	Foresthill
Three Queens	d	M. Savage	Foresthill	Foresthill
Plumas County				
Walker	a	Walker Mining Co.	Kerns Bldg., Salt Lake City, Utah	Walkermine
Sacramento County				
Capital	e	Capital Drdg. Co.	Balfour Bldg., San Francisco	Folsom
Natomas	e	Natomas Co.	Forum Bldg., Sacramento	Natomas
San Bernardino County				
Kelly & Uranium	a	Red Mountain Mines Synd.	Red Mountain	Red Mountain
Shasta County				
Iron Mountain	a	The Mountain Copper Co., Ltd.	112 Market St., San Francisco	Matheson
Sierra County				
Brush Creek	a	Kate Hardy Mng. Co., Ben F. Ballard	316 4th St., Santa Rosa	Goodyear's Bar
Kirkpatrick	b	Kirkpatrick Mines Co.	2208 N St., Sacramento	Goodyear Bar
Original 16 to 1	a	Original 16 to 1, Inc.	Russ Bldg., San Francisco	Alleghany
Siskiyou County				
Buzzard Hill and Independence	a	Buzzard Hill Mine, Inc.	Happy Camp	Happy Camp
Gum Boot	a	McInnes & McCool	Scotts Bar	Scotts Bar
McConnell Bar	f	W. B. Boulter	Hornbrook	Hornbrook
Stanislaus County				
La Grange	e	La Grange Gold Dredging Co.	Mills Bldg., San Francisco	La Grange
Trinity County				
Enterprise	a	Chiksan Oil Co., Ltd.	Helena	Helena
Jacobs Placer	g	Jacobs Estate	1210 Jackson St., Red Bluff	Junction City
Lewiston	e	Placer Development, Ltd.	58 Sutter St., San Francisco	Lewiston
Madrona	e	Madrona Dredging Co.	Junction City	Junction City
North Fork Placer	g	R. S. Chase	1052 Subway Terminal Bldg., Los Angeles	Helena
Paymaster	a	P. X. Johnson	Lewiston	Lewiston
Trinity	e	Trinity Dredging Co.	Lewiston	Lewiston

[1] Number does not include snipers, prospectors, and various individuals selling small lots to bullion dealers.
[2] Now taken over by the Empire-Star Mining Co., Ltd.
a. Lode mine. b. Placer mine. d. Pocket mine. e. Dredge. f. Drift mine. g. Hydraulic mining.

GOLD—Continued

Principal Gold Producers in California out of a Total of 959 Operators[1] of Placer and Lode Mines in 1931

Mine	Type of mine	Operator	Address	Location of mine
Tuolumne County				
Atlas	a	F. H. Bernard	R. F. D., Sonora	Tuttletown
Enterprise	a	Continental Mines Corp.	Columbia	Columbia
Fifty-five	a	Mother Lode Extension Mines, Inc.	2323 W. 6th St., Los Angeles	Merced Falls
Hidden Treasure	d	Sherman Wetmore	Columbia	Columbia
(pocket)	d	G. O. Long Estate	Hearst Bldg., San Francisco	Tuttletown
Sugarman-Niger	a	Sugarman Mines, Inc.	Columbia	Sonora
Yuba County				
Garden Valley	e	Garden Valley Dredge	Log Cabin	Camptonville
Red Cross	a	Red Cross Mining Co.	620½ I St., Sacramento	Dobbins
Yuba	e	Yuba Consl. Gold Field, Hammon Eng. Co.	351 California St., San Francisco	Hammonton

[1] Number does not include snipers, prospectors, and various individuals selling small lots to bullion dealers.
a. Lode mine. b. Placer mine. d. Pocket mine. e. Dredge. f. Drift mine. g. Hydraulic mining.

GRANITE

Operator	Product	Address	Location of quarry
Fresno County			
Academy Granite	a	Clovis	Clovis
Superior Granite Co., Inc.	a	Clovis	Academy
Lassen County			
Grieg Quarry, A. D. Grieg	a	Susanville	Susanville
Los Angeles County			
Desert Stone Co., H. A. Jones	c	295 Grant St., Pasadena	----------
Madera County			
McGilvray-Raymond Corp.	a	3 Potrero Ave., San Francisco	Raymond

Mariposa County			
Yosemite National Park	a	Yosemite	Yosemite Park
Placer County			
Alexson Granite Co.	a	Rocklin	Rocklin
A. Pernu Granite Quarries, Adolph Pernu	a	Rocklin	Rocklin
Union Granite Co., Mat Ruhkala	a	Rocklin	Rocklin
Plumas County			
Paul Sonognini	a	Chilcoot	Chilcoot
Riverside County			
N. B. Walters Quarry, N. B. Walters	a	28 Chapel St., Alhambra	Val Verde
Sacramento County			
Folsom State Prison	a	Represa	Represa
San Diego County			
American Marble & Granite Works	a	1212 E. 19th St., Los Angeles	Santee
Crystal Black Quarry, John Stridsburg	a	Escondido	Spooks Canyon
McGee Quarry, Robert J. McGee	a	Pala	Pala
Mission Silver-Gray Granite	a	3422 Union Pacific Ave., Los Angeles	Lakeside
San Luis Obispo County			
Fabbris-Carpentier Co.	b	275 Bush St., San Francisco	Acascadine
Shasta County			
Lassen Volcanic Nat'l Park	b	Mineral via Red Bluff	Lassen Park
Sonoma County			
L. R. De Chesne	c	Glen Ellen	Glen Ellen
Tulare County			
California Quarry, McGilvray-Raymond Corp.	a	3 Potrero Ave., San Francisco	Porterville
Ventura County			
G. W. Dryden	c	Fillmore	Grimes Canyon
Ritchie Bros., R. A. and J. A. Ritchie	c	Fillmore	Grimes Canyon

a. Granite used in building and monumental stone. b. Tuff used as building stone. c. Granite rock used as flagstone.

GYPSUM

Operator	Address	Location of quarry
Fresno County		
Paoli Gypsum Mine, A. P. Shepard, Mgr.	3101 Mariposa St., Fresno	Mendota
Imperial County		
Imperial Gypsum Quarry, Pac. Portland Cement	111 Sutter St., San Francisco	Plaster City
Kern County		
Koehn Gypsum Mine, Jennie E. Koehn	Saltdale	Saltdale
Riverside County		
E. R. Nonhoff	1116 Ramona St., Corona	Corona
U. S. Gypsum Co.	507 Architects Bldg., Los Angeles	Midland

IODINE

Operator	Address	Mine
Los Angeles County		
General Salt Co.	530 W. 6th St., Los Angeles	Long Beach

LEAD

Principal Lead Producers in California in 1931

Mine	Operator	Address	Location of mine
Inyo County			
Carbonate	Whitman Symmes	51 Shipley St., San Francisco	Zabriskie
Estelle and Cerro Gordo	American Smelting & Refining Co.	McCormick Bldg., Salt Lake, Utah	Keeler
Lead Lode	J. W. Ehrman	c/o Joseph Store, Big Pine	Zurich
Noonday	Tecopa Cons. Mining Co.	Tecopa	Tecopa
Ophir	Engineers Exploration Co.	702 California Reserve Bldg., Los Angeles	Trona
Santa Rosa	Santa Rosa Mines	Keeler	Keeler
Nevada County			
Murchie	American Foundation Co. (a)	P. O. Box 687, Nevada City	Nevada City
Spanish	Spanish Mining Co.	Crocker Bldg., San Francisco	Washington
San Bernardino County			
Buchan	Maurice Mulcahy	Daggett	Daggett

(a) Taken over by the Empire-Star Mining Co., Ltd., during the year.

LIME AND LIMESTONE

Operator	Product	Address	Location of quarry
Alameda County			
California Chemical Corp.	a, d	Box 8-A, Newark	Newark
El Dorado County			
Auburn Chemical Lime Co., Ltd.	a, b, c	Auburn	Newcastle
Diamond Springs Lime Co.	a, b	Diamond Springs	Diamond Springs
El Dorado Limestone Co., J. H. Bell, Receiver	b	Shingle Springs	Shingle Springs
Pac. Portland Cement Co., Cons.	b	111 Sutter St., San Francisco	Auburn
Fresno County			
Coral Reef Lime Corp., B. F. Mason, Mgr.	c	Dinuba	Reedley
Inyo County			
Inyo Chemical Co.	a	415 I. W. Hellman Bldg., Los Angeles	Cartago

a. Producer of burnt lime. b. Producer of limestone. c. Agricultural lime. d. Shells.

LIME AND LIMESTONE—Continued

Operator	Product	Address	Location of quarry
Mendocino County			
Northwest Lime & Sulphur Co., John Freitas	c	Ukiah	Laughlin
San Benito County			
San Benito Lime Kilns, A. E. Hamilton	a, b, c	Western Hotel, Hollister	Cienega
San Bernardino County			
Cal. Portland Cement Co.	a	1228 Pac. Mutual Bldg., Los Angeles	Colton
Chubbuck Lime Co., Chas. I. Chubbuck	a, b	5000 Worth St., Los Angeles	Chubbuck
Mojave Marl Co.	c	374 Court St., San Bernardino	Wild Siding
Victorville Lime Rock Co.	b	2149 Bay St., Los Angeles	Victorville
San Mateo County			
L. H. Beck	d	P. O. Box 113, Colma	Colma
Pacific Portland Cement Co.	c, d	111 Sutter St., San Francisco	San Mateo
Santa Clara County			
Bay Shell Co.	c, d	519 California St., San Francisco	Alviso
W. B. Ortley Shell Co.	d	Alviso	Alviso
Santa Cruz County			
Henry Cowell Lime and Cement Co., W. H. George, Mgr.	a, b	2 Market St., San Francisco	Santa Cruz
Holmes Lime & Cement Co.	a	Division and De Haro Sts., San Francisco	Felton
Pacific Limestone Prod. Co.	b	Spring St., Santa Cruz	Santa Cruz
Santa Cruz Port. Cement Co.	b	Crocker Bldg., San Francisco	Davenport
Tulare County			
Kaweah Quarries, A. C. Root, Owner	b	Lemoncove	Lemoncove
Valley Lime Co., E. H. McEuen	b	118 W. Honolulu St., Lindsay	Lindsay
Tuolumne County			
U. S. Lime Products Corp.	a, b	58 Sutter St., San Francisco	Sonora
Ventura County			
Papa Alta Lime & Fertilizer Co., Mrs. M. L. Franklin, Secy.	d	4336 Victoria Park Dr., Los Angeles	Santa Susana

a. Producer of burnt lime. b. Producer of limestone. c. Agricultural lime. d. Shells.

MAGNESITE

Operator	Address	Location of mine
Santa Clara County		
C. S. Maltby Magnesite Co., Ltd., Western Magnesite Mine	Humboldt Bank Bldg., San Francisco	Red Mountain
Stanislaus County		
California Magnesite Co.	1215 First National Bank Bldg., San Francisco	Red Mountain
Sierra Magnesite Co., Bald Eagle Mine	Box 8A, Newark	Gustine
Tulare County		
Sierra Magnesite Co.	Box 8A, Newark	Porterville

MAGNESIUM SALTS

Operator	Product	Address	Location of plant
San Diego County			
California Chemical Corp.	Chloride	Box 8A, Newark	San Diego
San Mateo County			
Marine Chemical Co., R. E. Clarke	Carbonate	South San Francisco	South San Francisco

MANGANESE ORE

Operator	Address	Location of spring
San Bernardino County		
Owl Holes Mine, J. W. Wood	247 Prospect Ave., San Bernardino	Silver Lake

MARBLE (Including Onyx and Travertine)

Operator	Product	Address	Location of quarry
Amador County			
California Carrara Marble, A. G. Dondero	a	2895 3d St., San Francisco	Pine Grove
Inyo County			
Inyo Marble Co.	a	361 N. Ave. 22, Los Angeles	Lone Pine
Santa Barbara County			
G. Antolini	b	111 E. Gutierrez St., Santa Barbara	Tajiguas
Solano County			
P. Grassi & Co.	c	1945 San Bruno Ave., San Francisco	Tolenas Springs
Tolenas Springs Onyx, L. Cardini	c	121 14th St., San Francisco	Tolenas Springs
Tuolumne County			
The Columbia Marble Co., R. H. Van Norden, Secy.	a	413 Rialto Bldg., San Francisco	Columbia

a. Marble. b. Limestone flagstone. c. Onyx and travertine

MICA

Operator	Address	Mine
Imperial County		
Micatalc, Inc., C. E. Allebrand	2440 E. 56th St., Los Angeles	Ogilby
Mineral Milling Co.	1081 Richmond St., Los Angeles	

MINERAL PAINT

Operator	Address	Location of mine
Placer County		
J. L. Williams	807 Broadway, Oakland	Forest Hill

Operator		Address	Location of spring
Butte County			
Richardson Springs, Lee Richardson, Mgr.		Chico	Chico
Calaveras County			
Mok-Hill Mineral Springs, L. Walkmeister, Prop.		Sutter Creek	Mokelumne Hill
Colusa County			
Cooks Springs, Fred C. Lewe, Lessee		Lodoga	Cooks Springs
Contra Costa County			
Alhambra Water Co.		Martinez	Martinez
Fresno County			
Mercey Mineral Springs Co., F. J. Bourn, Pres.		810 California Bldg., Los Angeles	Los Banos
Kern County			
Frazier Park Spring Water Co., Ltd.		Haberfeld Bldg., Bakersfield	
Inyo County			
Coso Hot Springs, Inc.		Coso Hot Springs	Coso Hot Springs
Lake County			
Adams Mineral Springs, Clarence Prather		Adams, via Middletown	Adams
Bartlett Spring Co.		163 Turk St., San Francisco	Bartlett Springs
Norman Mineral Springs, H. C. Norman, Mgr.		Middletown	Middletown
Witter Springs, Inc., J. A. Carroll, Pres.		62d and La Salle Sts., Chicago, Ill.	Witter Springs
Los Angeles County			
Cascade Water Co.		4556 York Blvd., Los Angeles	Los Angeles
Elysian Spring Water Co.		1536 Baxter, Los Angeles	Los Angeles
Holly Spring Water		2298 Holly Dr., Los Angeles	Los Angeles
Magnetic Spring Water Co.		936 Palm Ave., Sherman	Los Angeles
Mission Spring Water Co.		8938 Keith, Hollywood	Los Angeles
Mountain Spring Water Co.		226 S. Avenue 54, Los Angeles	Los Angeles
Pure-lax Mineral Water Co.		3640 Griffin, Los Angeles	Los Angeles
Rose Springs-California Spring Water Co.		4835 Pasadena Ave., Los Angeles	Los Angeles
Sparklett Bottled Water Co.		4500 York Blvd., Los Angeles	Los Angeles
Napa County			
Calistoga Bottling Works, G. Musante		Calistoga	Calistoga
Napa Soda Springs Co., G. H. T. Jackson		1142 Mission St., San Francisco	Napa
Napa Vichy Springs, John Lepori		Napa	Napa

MINERAL WATER—Continued

Operator		Address	Location of spring
Napa County—Continued.			
Samuels Soda Springs, R. J. Little		Monticello	Monticello
Walters Mineral Water, St. Helena Bottling and Cold Storage Co.		St. Helena	Pope Valley
Orange County			
La Vida Mineral Water Co.		927 W. 2d St., Los Angeles	Carbon Canyon
Placer County			
Ki-la-ga Co.		Lincoln	Valley
Riverside County			
Beulah Springs, Oscar C. McNicholl		Arlington	Arlington
San Bernardino County			
Arrowhead Hot Springs, California Consolidated Water Co.		1566 E. Washington Blvd., Los Angeles	Arrowhead
San Diego County			
Rock Springs Co., E. S. Walck		R. 2, Box 442, Escondido	Escondido
San Francisco County			
Blue Crest Mineral Water Co.		615 Excelsior Ave., San Francisco	San Francisco
San Luis Obispo County			
Mary Hill Mineral Well Co., Fred Merckel		Paso Robles	Paso Robles
Santa Barbara County			
Veronica Mineral Springs Co.		699 Brannan St., San Francisco	Santa Barbara
Santa Clara County			
San Jose Water Co., C. Wood		459 Minor Ave., San Jose	Alma
Siskiyou County			
The Shasta Water Co.		6th and Brannan Sts., San Francisco	Dunsmuir
Yreka Coco Cola Bottling Works, Fred J. Meamber, Prop.		Yreka	Little Shasta
Sonoma County			
Agua Caliente Springs Co., T. H. Corcoran, Prop.		Agua Caliente	Agua Caliente
Boyes Springs Bottling Works, F. W. Peterson, Mgr.		Boyes Springs	Boyes Springs
Barcal Springs, John Kolling		Preston	Preston
Fetters Mineral Springs, George Fetters		Fetters Springs	Fetters Springs

PLATINUM

Operator		Address	Location of mine
Butte County			
Shasta-Butte Gold Dredging Co.		Oroville	Oroville
Sacramento County			
Capital Dredging Co.		Balfour Bldg., San Francisco	Folsom
Stanislaus County			
La Grange Gold Dredging Co.		Mills Bldg., San Francisco	La Grange
Shasta County			
Gas Point Dredge, Trautz & Green		Cottonwood	Gas Point
Trinity County			
Madrona Dredging Co.		Junction City	Junction City
W. L. Parsons		Salyer	Salyer
Salyer Consolidated Gold Mining Co.		Salyer	Salyer
Yuba County			
Yuba Consolidated Gold Fields		351 California St., San Francisco	Hammonton

POTASH

Operator		Address	Location of plant
San Bernardino County			
American Potash and Chemical Co.		Trona	Trona

PUMICE OR VOLCANIC ASH

Operator	Product	Address	Location of quarry
Fresno County			
Earlonite Mining Co., L. T. Bennett and Earl Bennett	b	P. O. Box 474, Selma	Friant
Fort Miller Pumicite, A. H. McKenzie	b	Griffith-McKenzie Bldg., Fresno	Friant
Imperial County			
The Kalite Co., O. J. Salisbury	a	90 Oak Knoll Ave., Los Angeles	Calipatria
Mineral Milling Co.	a	1081 Richmond St., Los Angeles	Estelle
Inyo County			
Chas. Brown	a	Shoshone	Shoshone
Victorville Lime Rock Co.	a	2149 Bay St., Los Angeles	Coso Junction
Kern County			
Cudahy Packing Co.	b	803 Macy St., Los Angeles	Ceneda
Mono County			
California Quarries Corp.	a	1300 Quinby Bldg., Los Angeles	Laws
San Bernardino County			
Hill Bros. Chemical Co.	a	2159 Bay St., Los Angeles	Daggett
San Luis Obispo County			
Golden State Cleaner Mine, M. L Francis	b	Creston	Creston
Siskiyou County			
G. Z. Johnson	a, c	255 California St., San Francisco	Pumice Mountain
J. O. Miller and E. L. Jameson	a	Mt. Shasta	Leaf

a. Pumice. b. Volcanic ash. c. Scoria.

PYRITE

Operator	Product	Address	Location of mine
Alameda County			
Leona Chemical Co., D. A. McDonnell		Syndicate Bldg., Oakland	Leona Heights
Shasta County			
Mountain Copper Co., Wm. F. Kett, Mgr.		112 Market St., San Francisco	Matheson

QUICKSILVER

Mine	Operator	Address	Location of mine
Colusa County			
Manzanita	Shanjay Quicksilver Mining Co.	260 California St., San Francisco	Wilbur Springs
Fresno County			
Mercey	Benj. C. Warnick	1218 Locust St., Philadelphia, Pa.	Little Panoche Creek
Inyo County			
	Wm. Symons	Laws	
Kern County			
Cuddeback	Santa Ana Mining Co., C. D. Holmes, Jr., Pres.	1408 N. Main St., Santa Ana	Tehachapi
Kings County			
Dawson	C. E. Linville	2850 Webster St., Berkeley	Parkfield
Lake County			
Big Chief	L. R. Messer	Middletown	Anderson Springs
Great Western	Bumsted Mining Co., E. J. Bumsted, Mgr.	Middletown	Middletown
Mirabel	Mirabel Quicksilver Co., J. W. Doman, Supt.	Middletown	Middletown
Red Elephant	Forrest D. Saunders	2715 Franklin St., San Francisco	Rieff
Sulphur Bank	Sulphur Bank Syndicate, W. Bradley, Mgr.	Clear Lake	Lower Lake
Wilkenson Bros.	E. J. Wilkenson	Middletown	Middletown

QUICKSILVER—Continued

Mine	Operator	Address	Location of mine
Napa County			
Aetna	Chas. A. Gray	Financial Center Bldg., San Francisco	Aetna Springs
Bella Oaks	H. W. Gould & Co.	Mills Bldg., San Francisco	Rutherford
Hammer Bros.	Frank Hammer	Pope Valley	Pope Valley
La Joya	Lucky Strike Mining Co.	381 Bush St., San Francisco	Oakville
Mt. St. Helena	Harry Patten	Calistoga	St. Helena
Oat Hill	Acme Mining & Milling Co.	Alto Bldg., San Francisco	Oat Hill
San Benito County			
Aurora	John Turpen	Idria via Fresno	Idria
Black Hawk	C. F. Cook	Coalinga	Idria
Florence Mac	Joe Stokes	1252 Pine Ave., Long Beach	Hernandez
New Idria	New Idria Quicksilver Mines, Inc.	Merchants Exchange Bldg., San Francisco	Idria
Stayton	R. B. Knox	Hollister	Hollister
Wonder	Geo. W. McCutcheon	c/o Sampson Magnesite Mine, Tres Pinos	Tres Pinos
San Luis Obispo County			
Carson	Ellard W. Carson	San Luis Obispo	Adelaida
Deer Trail	The Alamo Mercury Corp., J. C. Freeman	873 Church St., San Luis Obispo	Huasna
Little Bonanza	L. D. Purdy	Adelaida	Adelaida
Oceanic	Consolidated Metals Corp.	Mills Bldg., San Francisco	Cambria
Rinconada	Mercury Corp. of America, Ltd.	Box 537, Santa Monica	Santa Margarita
Santa Barbara County			
Los Prietos	Los Prietos Quicksilver Mining Co., F. M. Townsend	912 Higgins Bldg., Los Angeles	Los Prietos
Santa Clara County			
New Almaden (dump)	Ben Black	Almaden	Almaden
Siskiyou County			
Great Northern	Mercury Mines, Eugene Aureguy	Mills Bldg., San Francisco	Gottville
Sonoma County			
Cloverdale	Cavagnaro & Schor*	Cloverdale	Cloverdale
Cloverdale	Nevada Quicksilver Co.	Lovelock, Nev.	Cloverdale
Culver Bear	H. C. Davey	Cloverdale	Cloverdale
Espernanza	Dr. Geo. T. Pomeroy	102 E. San Fernando Blvd., Burbank	Cloverdale
Skaggs	Leo Curtis	Skaggs Springs	Skaggs Springs
Trinity County			
Altoona	Altoona Quicksilver Mining Co., J. Frowenfield, Pres.	2446 Washington St., San Francisco	Castella

*Operated from August, 1931, by Cavagnaro & Schor.

Operator		Address	Location of plant
Alameda County			
Arden Salt Co.		225 Bush St., San Francisco	Newark and Mt. Eden
California et al. Plants, Leslie-California Salt Co.		149 California St., San Francisco	Alvarado
Kern County			
Consolidated Salt Co.		P. O. Box 28, Long Beach	Saltdale
Los Angeles County			
Long Beach Salt Co.		P. O. Box 28, Long Beach	Long Beach
Modoc County			
Surprise Valley Salt Works, Joshua H. Hutchinson		Box 26, Lake City	Lake City
Mono County			
Wallis D. McPherson		Mono Lake	Mono Lake
Monterey County			
Monterey Bay Salt Co., E. C. Vierra, Mgr.		Moss Landing	Moss Landing
San Bernardino County			
California Rock-Salt Co.		2465 Hunter St., Los Angeles	Amboy
Saline Products, Inc.		2000 Santa Fe Ave., Los Angeles	Amboy
San Diego County			
Western Salt Co.		917 J. D. Spreckels Bldg., San Diego	San Diego
San Mateo County			
Stauffer Chemical Co.		636 California St., San Francisco	Redwood City

SANDSTONE

Operator		Address	Location of quarry
Los Angeles County			
Blue Goose Quarry, Robert Cox		1975 Lundy Ave., Pasadena	Saugus
R. L. Glover		Rt. 2, Canoga Park	Canoga Park
Daniel J. Poyer		Canoga Park	Canoga Park
Monterey County			
Carmel Stone Quarries, Arthur H. Anthony		2752 Filbert St., San Francisco	Carmel
Santa Lucia Quarries, Ltd., John Bathen		Carmel	Carmel
Sierra Quarry, Harry Rogers		Box 136, Carmel	Carmel
Napa County			
H. F. Galbreath		1742 Solano St., Berkeley	
San Luis Obispo County			
Santa Rosa Creek Quarry, L. C. Davis		Cambria	Cambria

Operator	Product	Address	Location of mine
Contra Costa County			
Silica Co. of California, Ltd., R. M. Greathouse	b	Merchants Exchange Bldg., San Francisco	Brentwood
El Dorado County			
Snow Silica Deposit, Spicky Polish Corp., Owners	a	1401 3d St., San Francisco	Placerville
Mariposa County			
James Helm & P. Carmean	a	Le Grand	Le Grand
Monterey County			
Del Monte Products, A. J. Gunnell	b	Crocker Bldg., San Francisco	Del Monte
Placer County			
Harry McCormack	a	Alta	Alta
Riverside County			
American Encaustic T. Co.	a	52d and S. Alameda Sts., Los Angeles	Murrietta
P. J. Weisel	b	La Habra	Corona
San Bernardino County			
Dr. J. Von Gal-Scale	a	618 S. Bixel St., Los Angeles	----------
San Diego County			
Mineral Milling Co.	a	1081 Richmond St., Los Angeles	White Oak Springs
Standard Sanitary Mfg. Co., R. P. Jones, Mgr.	a	Campo	Campo

a. Quartz. b. Glass sand.

SILLIMANITE—ANDALUSITE—CYANITE GROUP

Operator	Product	Address	Location of mine
Imperial County			
Vitrefrax Corp.	Cyanite	5050 Pacific St., Vernon, Los Angeles	Ogilby
Mono County			
Champion Porcelain Co., Dr. J. A. Jeffery, Pres.	Andalusite	Butler Ave., and Grand Trunk R. R., Detroit, Mich.	Mocalno

SILVER

Principal Silver Producers in California in 1931

Mine	Type of Mine	Operator	Address	Location of mine
Amador County				
Argonaut	a	Argonaut Mining Co.	1404 Humboldt Bk. Bldg., San Francisco	Jackson
Old Eureka	a	Central Eureka Mg. Co.	111 Sutter St., San Francisco	Sutter Creek
Kennedy	a	Kennedy Mg. and Mg. Co.	519 California St., San Francisco	Martell
Butte County				
La Plumas	a	C. W. Erickson	Yankee Hill	Yankee Hill
Calaveras County				
Royal	a	Western Empire Mines Co., Ltd.	Milton	Milton
Inyo County				
Carbonate	c	Whitman Symmes	51 Shipley St., San Francisco	Zabriskie
Estelle & Cerro Gordo	c	American Smelting & Refining Co.	McCormick Bldg., Salt Lake, Utah	Keeler
Kern County				
Standard	a	Standard Mining Co.	Bank of America Bldg., San Diego	Mojave
Napa County				
Palisade	b	Banner Development Co., Andrew Rocca, Receiver	Calistoga	Calistoga

Nevada County				
Empire and North Star	a	Empire Star Mines Co., Ltd.	14 Wall St., New York, N. Y.	Grass Valley
Idaho-Maryland	a	Idaho-Maryland Mines Co.	Russ Bldg., San Francisco	Grass Valley
Murchie*	a	American Foundation Co.	P. O. Box 687, Nevada City	Nevada City
Spanish	a	Spanish Mining Co.	Crocker Bldg., San Francisco	Washington
Plumas County				
Walker	d	Walker Mining Co.	Kearns Bldg., Salt Lake City, Utah	Walkermine
Sacramento County				
Natomas	a	Natomas Co.	Forum Bldg., Sacramento	Natomas
San Bernardino County				
Kelly & Uranium group	b	Wortley Cons. Mines, Inc.	Red Mountain	Red Mountain
Shasta County				
Hornet	a	The Mountain Copper Co., Ltd.	112 Market St., San Francisco	Matheson
Sierra County				
Original 16 to 1	a	Original 16 to 1, Inc.	Russ Bldg., San Francisco	Alleghany
Yuba County				
Yuba	a	Yuba Cons. Gold Field, Hammon Eng. Co.	351 California St., San Francisco	Hammonton

*Taken over by the Empire-Star Mines Co., Ltd.
a. Gold. b. Silver. c. Silver-Lead. d. Copper.

SLATE

Operator		Address	Location of quarry
El Dorado County			
Pacific Minerals Co., Ltd.		332 10th St., Richmond	Chili Bar
Tuolumne County			
Witney Slate Quarry, W. S. McLean		1919 San Bruno Ave., San Francisco	Hetch Hetchy

SOAPSTONE AND TALC

Operator	Product	Address	Location of mine
Butte County			
McLean Talc Deposit, W. S. McLean	a	1919 San Bruno Ave., San Francisco	McLean Spur
El Dorado County			
Pacific Minerals Co., Ltd., Chas. S. Renwick	a	337 10th St., Richmond	Shrub
Inyo County			
Sierra Talc Co., Franklin Booth, Mgr.	b	428 Union League Bldg., Los Angeles	Keeler
San Bernardino County			
Pacific Coast Talc Co.	b	2149 Bay St., Los Angeles	Silver Lake
Western Talc Co.	b	1901 E. Slauson Ave., Los Angeles	Death Valley
Tuolumne County			
John L. Witney	a	Jamestown	Jamestown

a. Soapstone. b. Talc.

SODA

Operator	Product	Address	Location of plant
Inyo County			
Inyo Chemical Co.		415 I. W. Hellman Bldg., Los Angeles	Cartago
Natural Soda Products Co., W. W. Waterson		709, 215 W. 6th St., Los Angeles	Keeler
Pacific Alkali Co.		1206 Pacific Mutual Bldg., Los Angeles	Bartlett
San Bernardino County			
West End Chemical Co.		West End	Searles Lake

Under the heading of stone, miscellaneous, there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

NOTE.—The California State Highway Commission produces both crushed rock and sand and gravel in various places in the state used in construction and maintenance of highways, but not specified in this listing.

Operator	Product	Address	Location of pit or quarry
Alameda County			
Bilger Property Co., Mr. F. W. Bilger	b	5000 Broadway, Oakland	Oakland
Hanifen Trucking Co.	a	Pleasanton	Pleasanton
Hayward Building Materials Co., Stevenson Gravel Pit	a	Atherton & Jackson Sts., Hayward	Decoto
Heafey-Moore Co., Leona Quarry	b	344 High St., Oakland	Oakland
J. F. Johnson	a	P. O. Box 232, Livermore	Livermore
Kaiser Paving Co.	a	1522 Latham Square Bldg., Oakland	Eliot
Kemper Bros.	b	Rt. 1, Box 197, Strabridge Ave., Hayward	Hayward
Langdon Molding Sand, J. H. Langdon	c	R. F. D., Box 89, Niles	Decoto
Red Shale Quarry, W. S. McLean	d	1919 San Bruno Ave., San Francisco	Arroyo Mocho
Mtn. View Cemetery Assn.	b	Oakland	Piedmont
Pacific Coast Aggregates, Inc.	a, b	85 2d St., San Francisco	Eliot and Niles
Ramos Quarry, Ramos Bros.	a	C and 7th Sts., Hayward	Hayward
Russell Bros. Quarry, B. and L. Russell	b	1192 Russell Way, Hayward, California	Hayward
San Leandro Rock Co., Lake Chabot Quarry	b	1273 Foothill Blvd., San Leandro	Lake Chabot
Southern Pacific R. R. Co.	a	Southern Pacific Bldg., San Francisco	Niles and Radum
Amador County			
Amador County	a, b	Jackson	----------
Pacific Gas and Elec. Co.	b	245 Market St., San Francisco	Salt Springs
Butte County			
Butte County	a, b	Oroville	----------
Rufus Bean	a	Clipper Mills	Clipper Mills
Bechtel-Kaiser Co., R. J. Kennedy, Mgr.	b	Oroville	Oroville
Cherokee Sand and Gravel Co., C. W. & E. E. Myers	a	R. 4, Box 127, Chico	Cherokee Flat
J. E. Johnston Rock Co.	a	Chico	Chico
McLean Quarry	d	1919 San Bruno Ave., San Francisco	McLean Spur
Pacific Coast Aggregates, Inc.	a, b	85 2d St., San Francisco	Oroville

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag. f. Tube mill pebbles. g. Decomposed granite.

STONE, MISCELLANEOUS—Continued

Under the heading of stone, miscellaneous, there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

Operator	Product	Address	Location of pit or quarry
Calaveras County			
Calaveras County	a	San Andreas	
Pacific Gas & Electric Co.	b	245 Market St., San Francisco	Salt Springs
Pacific Minerals Co., Ltd.	d	337 10th St., Richmond	Angels
U. S. Bureau of Public Roads	b	461 Market St., San Francisco	
Colusa County			
Colusa County	a	Colusa	
Contra Costa County			
Contra Costa County	a	Martinez	
Antioch Sand Co.	a	312 Loew Bldg., San Francisco	Antioch
Blake Bros. Co., Anson S. Blake	b	204 Balboa Bldg., San Francisco	Point Richmond
Hutchison Co., Stege Quarry	b	1450 Harrison St., Oakland	Stege
E. B. & A. L. Stone Co., Antioch Sand Pit	a	810 Claus Spreckels Bldg., San Francisco	Antioch
Morris Sand Pit, Ben Morris	a	Antioch	Antioch
Oak Point Sand Co.	a	Antioch	Antioch
Thomas G. Roberts	c	Pittsburg	Nortonville
Silico Co. of Calif., Ltd.	c	Merchants Exchange Bldg., San Francisco	Brentwood
Del Norte County			
Del Norte County	a	Crescent City	
El Dorado County			
El Dorado County	b	Placerville	Georgetown
Diamond Springs Lime Co.	b	Diamond Springs	Diamond Springs
Fresno County			
Grant-Service Rock Co., Cons.	a, b	T. W. Patterson Bldg., Fresno	El Prado
Pacific Coast Aggregates, Inc.	b	85 2d St., San Francisco	Piedra
Southern Calif. Edison Co., Ltd.	a	Edison Bldg., Los Angeles	
Glenn County			
Stony Creek Gravel Co., H. S. Tweed	a	Willows	Wyo.

Humboldt County			
Humboldt County	a, b	Eureka	
Benbow Rock and Gravel Co.	a	Garberville	Garberville
J. Ferguson	a	Arcata, R. F. D.	Arcata
Hemstreet & Bell	a, b	411 C St., Marysville	
Northwestern Pacific R. R. Co., Wm. N. Neff, Gen. Supt.	a	Sausalito	South Fork
Mercer Fraser Co.	a	Second and Commercial Sts., Eureka	Essex & Fernbridge
Imperial County			
Imperial County	a, b	El Centro	
Imperial Irrigation Dist., Gen. Supt. River Div.	b	Andrade	Andrade
Imperial Rock Corp.	a, b	P. O. Box 6, Niland	Niland
S. E. Layman	a	Holtville	Holtville
Potholes Granite Quarry, U. S. Bureau of Reclamation	b	Winterhaven, c/o Yuma, Arizona	Winterhaven
Inyo County			
Inyo County	a	Independence	
Inyo Marble Co.	b, d	406 S. Main St., Los Angeles	Lone Pine
Kern County			
Kern County	a	Bakersfield	
Bakersfield Rock and Gravel Co.	a, b, h	Box 395, Station A, Bakersfield	
Kern Rock Co., Ltd.	a, b	P. O. Box 1697, Bakersfield	Kern River
Klassen Sand Pit, P. P. Klassen	a	1010 31st St., Bakersfield	Bakersfield
T. P. Pyle Sand Co.	a	514 30th St., Bakersfield	Bakersfield
A. Teichert & Son, Inc.	a	1846 37th St., Sacramento	Bakersfield
Lake County			
Lake County	a	Lakeport	
Jim Gunn, Jr.	a	Kelseyville	Kelseyville
Chas. Kuppinger	a, h	Lakeport	Lakeport
Los Angeles County			
Associated Rock Co.	b	1000 N. La Brea St., Los Angeles	
A. T. & S. F. R. R., I. L. Hibbard, Gen. Mgr.	a	609 Kerekhoff Bldg., Los Angeles	Forbes
Richard R. Ball	a	Box 233, Walteria	Walteria
Bengal & Sons	a	1709 Monte Vista, Pasadena	Pasadena
Blue Diamond Corp., Ltd.	a	1650 S. Alameda St., Los Angeles	El Monte and Roscoe
Wm. J. Bonfield	g	2008 Laurel Canyon Rd., Los Angeles	Hollywood
Bouquet Canyon Flagstone Co., W. H. Binder, Mgr.	b	285 N. Lake Ave., Pasadena	Saugus

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag. f. Tube mill pebbles. g. Decomposed granite. h. Earth.

STONE, MISCELLANEOUS—Continued

Under the heading of stone, miscellaneous, there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

Operator	Product	Address	Location of pit or quarry
Los Angeles County—Continued.			
Consolidated Rock Products Co.	a, b	656 S. Los Angeles St., Los Angeles	Whittier and Fullerton
Ducey & Atwood Rock Co., R. K. Atwood, Pres.	a, b	Box 194, East Pasadena	East Pasadena
Eaton Canyon Rock and Sand Co.	a, b	2350 E. Colorado St., Pasadena	Pasadena
Graham Bros.	a, b g	Long Beach	Catalina Island and Roscoe, El Monte and Rancho Qua's
Lindauer Corp.	a	Box 208, La Habra	La Habra
Los Angeles City Rock and Gravel Plants, Engineer's Office	a	Los Angeles	Los Angeles
Los Angeles Harbor Dept., Bureau of Maintenance	b	City Hall, San Pedro	Santa Catalina
Los Angeles Decomposed Granite Co.	g	2171 W. Washington, Los Angeles	
Reynolds Crushed Gravel	g	920 N. Humphreys Ave., Los Angeles	Los Angeles
Santa Catalina Island Co.	a, b, g	Avalon	Santa Catalina Island
Edwin Sidebotham & Son, Inc., Sidebotham Sand Plant	a	McFarland and L Sts., Wilmington	Lomita
Southern Pacific Co.	a, b	65 Market St., San Francisco	Roscoe
Walter L. Stine	a	Burbank	Lankershim
Madera County			
Madera County	a, g	Madera	
Marin County			
Marin County	a	San Rafael	
Daniels Con. Co.	b	503 Market St., San Francisco	San Rafael
Hutchison Company	b	1450 Harrison St., Oakland	San Quentin
Mariposa County			
Mariposa County	a	Mariposa	
Kelm Jasper Quarry, H. J. Kelm	d	Merced Falls	Bagby
Yosemite National Park	a, b	Yosemite	Yosemite Ntl. Park
Mendocino County			
Mendocino County	a	Ukiah	
Ukiah Gravel & Cement Co., John Freitas	a	Ukiah	Ukiah

Merced County			
Merced County	a	Merced	Los Banos
Hammatt Gravel Plant, V. M. Hammatt	a, b	Livingston	Livingston
J. W. Huffman, Bair Creek Gravel Pit	a	Merced	Merced
Modoc County			
Modoc County	a	Alturas	
The Renshaw Sand, Rock & Gravel Co.	a	Alturas	Alturas
Southern Pacific Co.	a	65 Market St., San Francisco	Stronghold
Mono County			
California Quarries Corp.	a	1300 Quimby Bldg., Los Angeles	Laws
Monterey County			
Del Monte Properties, A. J. Gunnell	a, c	401 Crocker Bldg., San Francisco	Pacific Grove
Wm. Machado	a	Box 424, Carmel	Carmel
Monterey Sand Co.	a, c	Monterey	Monterey
M. J. Murphy	a, b	Monte Verde and 9th Sts., Carmel	Carmel
Pacific Coast Aggregates, Inc.	a	85 2d St., San Francisco	Lapis and Prattco
S. Ruthven, Seaside Sand Pit	a	Seaside	Seaside
Southern Pacific Co.	a	65 Market St., San Francisco	Lapis
A. Teichert & Son	b	1846 37th St., Sacramento	
Napa County			
Napa County	a, b	Napa	Napa
Basalt Rock Co.	b	8th St., Napa	Napa
John Cassaretto	a	6th and Channel Sts., San Francisco	Napa
Errington Quarry, Ray Errington	a	Napa	Napa
John Fox, Fox Property	a	St. Helena	St. Helena
City of St. Helena Gravel Pit	a	St. Helena	St. Helena
Napa & Calistoga S. F. R. R., Butala Gravel Pit	a	Napa	St. Helena
Thorsen Gravel Pit, Harry Thorsen	a	St. Helena	St. Helena
Nevada County			
Nevada County	b	Nevada City	
Orange County			
Orange County	g	Santa Ana	
Consolidated Rock Products Co.	a, b	656 S. Los Angeles St., Los Angeles	Whittier and Fullerton
Graham Bros.	a	Long Beach	El Modena
A. J. Jorgensen	a	Garden Grove	Garden Grove

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag. f. Tube mill pebbles. g. Decomposed granite.

STONE, MISCELLANEOUS—Continued

Under the heading of stone, miscellaneous, there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

Operator	Product	Address	Location of pit or quarry
Orange County—Continued			
National Cement Pipe Co.	a	Drawer K, Santa Ana	Santa Ana
Reynolds Gravel Service	g	715 Hickory St., Santa Ana	Santa Ana
Sparks & McClellan	a	R. 3, Box 244, Anaheim	Olive
Spurlock Sand Pit	a	Garden Grove	Garden Grove
B. A. Stoffel	a	Anaheim	Anaheim
Placer County			
Placer County	a	Auburn	----------
Alexson Granite Co.	b	Rocklin	Rocklin
A. Pernu Granite Quarries, Adolph Pernu	b	Rocklin	Rocklin
Roseville Sand Co.	a	Roseville	Roseville
Union Granite Co., Mat Ruhkala	b	Rocklin	Rocklin
Plumas County			
Western Pacific R. R. Co., E. W. Mason, Gen. Supt.	a, b	Mills Bldg., San Francisco	----------
Riverside County			
Riverside County	a	Court House, Riverside	----------
Kumpe-Hauser Construction Co., Ormand Quarry	b	Security Bldg., Long Beach	Bly Junction
Kuster & Waterburg	a	Corona	Corona
Nevada-Pacific Mineral Co., Inc.	c	3363 Fruitland Rd., Los Angeles	Grand Terrace
City of Riverside	b	Riverside	Riverside
The Service Gravel Co., F. A. Braman	a	4324 10th St., Riverside	Riverside
P. J. Weisel, Industrial Sands	a, c	La Habra	Corona
Sacramento County			
Cannon & Co.	c	Box 281, Sacramento	Ben Ali
Construction Materials Co.	a	24th St. and American River, Sacramento	American River
Del Paso Rock and Gravel Co.	a, b	H St. Rd., Sacramento	Del Paso
Folsom State Prison	b	Represa	Represa
Pacific Coast Aggregates, Inc.	a, b	85 2d St., San Francisco	Fair Oaks, Mayhew and American River

San Benito County			
San Benito County	a	Hollister	
Granite Rock Co.	b	Drawer M, Watsonville	Logan
Southern Pacific Co.	b	65 Market St., San Francisco	Logan
San Bernardino County			
San Bernardino County	b	San Bernardino	
Consolidated Rock Products Co.	a, b	656 S. Los Angeles St., Los Angeles	
Declezville Stone Co., Ltd.	b	Box 698, San Pedro	S. Fontana
Hanawalt Bros.	a, b	2151 D St., La Verne	La Verne
V. P. Hunt	a	Redlands	Redlands
Pacific Minerals, Inc.	d	337 10th St., Richmond	Barstow
Pinneys Sand & Rock Service	a, b	Redlands	Redlands
Redlands Gravel Co.	a, b	Redlands	Redlands
San Bernardino Rock and Gravel Co.	a	941 E St., San Bernardino	San Bernardino
San Diego County			
Calavera Rock Corp.	b	Oceanside	Oceanside
Canyon Rock Co.	a, b	3911 5th Ave., San Diego	San Diego
Paul Challet	a	2155 Newton St., San Diego	San Diego
Crystal Silica Sand Co.	a	Oceanside	Oceanside
Daley Corp., George Daley	a, b	4440 Boundary St., San Diego	San Diego
V. R. Dennis Construction Co.	a	P. O. Box F, Sta. A., San Diego	San Diego
H. G. Fenton Material Co.	a	13th and Imperial Ave., San Diego	San Diego
R. E. Hazard Construction Co., Inc.	b	2548 Kettner Blvd., San Diego	Rancho Santa Fe
F. L. Hicatt	c	P. O. Box 865, San Diego	San Diego
R. M. Hubbard	c	406 W. Nutmeg St., San Diego	San Diego
John T. Momand	f	Box 381, Carlsbad	Oceanside
National Sand Co., A. S. Johnson	a	Box 315, National City	National City
Nelson & Sloan	a	P. O. Box 832, Chula Vista	Chula Vista
Oceanside Rock & Sand Co.	a	Carlsbad	Oceanside
Simpson-Pirnie Granite Co.	h	21st and N Sts., San Diego	Santee
Spreckels Commercial Co.	a, b	310 4th St., San Diego	Otay and San Diego
W. A. Thompson	a	3521 Eugene Pl., San Diego	
Vista Rock and Sand Co.	a, g	Box 165, Vista	Vista
San Francisco County			
Mission Quarry Co.	b	210 Balboa Bldg., San Francisco	San Francisco
San Joaquin County			
San Joaquin County	a	Stockton	
Frank Marks	a, b	Newman	Tracy
Pacific Coast Aggregates, Inc.	a, b	85 2d St., San Francisco	Riverbank
Santa Fe Sand and Gravel Co., W. A. Arlington	a	P. O. Box 271, Escalon	Escalon

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag. f. Tube mill pebbles. g. Decomposed granite. h. Paving block.

STONE, MISCELLANEOUS—Continued

Under the heading of stone, miscellaneous, there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

Operator	Product	Address	Location of pit or quarry
San Luis Obispo County			
San Luis Obispo County	a	San Luis Obispo	
Granite Rock Co., Templeton Sand Plant	a	Drawer M, Watsonville	Templeton
Guiton Molding Sand, Harold E. Guiton	c	Oceano	Oceano
San Mateo County			
San Mateo County	b	Redwood City	
H. E. Casey Co.	b	3d and B Sts., San Mateo	
Daly's Quarry, Market St. Ry. Co.	b	58 Sutter St., San Francisco	Daly
Half Moon Bay Feed & Fuel Co., Torpy Quarry	b	Half Moon Bay	Half Moon Bay
Holy Cross Cemetery	b	Colma	Colma
Industrial Mineral Products, W. B. Vestal	c	970 7th St., San Francisco	
Marsh & Cunha, Vasques Quarry	b	Main St., Half Moon Bay	Half Moon Bay
Ratterree Bros. Co.	b	400 Walbridge Blvd., San Francisco	South San Francisco
Santa Barbara County			
Santa Barbara County	b	Santa Barbara	
Cutlin Ranch Pit, Fred S. Barrick	a	Carpinteria	Carpinteria
Gates Gravel Plant, Frank H. Gates	a, b	Santa Maria	Sisquoc
Lompoc, P. C. Schuck, St. Supt.	a	Lompoc	Lompoc
Santa Clara County			
County Surveyor, Santa Clara County	b	Hall of Records, San Jose	
Arrowhead Gravel Co., A. J. Raisch	a	305 Burrell Bldg., San Jose	Guadalupe Creek
Beasworrick Gravel Pit, Beasworrick Bros.	a	75 W. Howe St., San Jose	San Jose
Bright Gravel Co., William H. Bright	a	740 S. 3d St., San Jose	Coyote Creek
Carroll Gravel Pit, R. D. Carroll	a	Rt. 4, Box 310A, San Jose	San Jose
Hutchison Co., Stanford Quarry	b	1450 Harrison St., Oakland	Palo Alto
A. G. Jahn	a	Rt. 4, Box 362, San Jose	San Jose
Jas. A. Lemieux	a	Box 341, Senter Rd., San Jose	San Jose
Los Gatos Sand and Gravel Co.	a	Los Gatos	Los Gatos
J. W. Lovejoy	b	Rt. 1, Box 88, Mountain View	Mountain View
Martin Bros.	a	1350 Alviso St., Santa Clara	Coyote Creek
Pacific Coast Aggregates, Inc.	a, b	85 2d St., San Francisco	Coyote and Campbell

City of San Jose Sandpits, City Manager	a	San Jose	Coyote Creek
Southern Pacific Co.	a	65 Market St., San Francisco	Coyote and Alamitos
Taaffe Construction Co.	b	Los Altos	Los Altos
Union Paving Co.	b	5th and Keys Sts., San Jose	San Jose
Santa Cruz County			
Atlas-Olympia Co.	a	209 Underwood Bldg., San Francisco	Olympia
Central Supply Co.	a	P. O. Box 524, Santa Cruz	Santa Cruz
Mead Felton, S. & G. Co., Harvey Mead	a	Felton	Felton
Geyer Gravel Plant. J. C. Geyer	a	Santa Cruz	Santa Cruz
Pacific Limestone Prod. Co.	b	Santa Cruz	Santa Cruz
Santa Cruz Portland Cement Co.	b	Crocker Bldg., San Francisco	Davenport
Shasta County			
Shasta County	a, b	Redding	----------
Crews Gravel Pit, Philip Crews	a	17 N. Pine St., Redding	Sacramento River
Diestelhorst Gravel Plant, Chas. Diestelhorst	a, b	1040 Liberty St., Redding	Redding
Lassen Volcanic Nat. Park	b	Mineral via Red Bluff	Lassen Nat. Park
U. S. Bureau of Public Roads	b	461 Market St., San Francisco	----------
Sierra County			
Sierra County	a	Downieville	----------
Otto Hirsch	a	Irvington	Comptonville
U. S. Bureau of Public Roads	b	461 Market St., San Francisco	----------
Siskiyou County			
Siskiyou County	a, b	Yreka	----------
W. D. Miller Cons. Co.	a	Klamath Falls, Ore.	Graham Siding
J. B. Russell, Oberlyn Hill Quarry	b	Box 344, Yreka	Yreka
A. Young	b	Yreka	Yreka
Solano County			
Cordelia Rock Quarry, F. B. and A. L. Stone Co.	b	Claus Spreckels Bldg., San Francisco	Thomasson
Sonoma County			
Sonoma County	a, b	Santa Rosa	----------
Basalt Rock Co.	a	8th St., Napa	Healdsburg
S. Cabrol	b	Glen Ellen	Glen Ellen
Commercial Gravel Co., H. G. Burrowes	a	530 Mills Bldg., San Francisco	Geyserville
Hein Bros. Basalt Rock Co., Mark Hein, Pres.	b	Petaluma	Petaluma
Helberg Gravel Plant	a	Rt. 1, Sonoma	Shellville

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag. f. Tube mill pebbles g. Decomposed granite.

STONE, MISCELLANEOUS—Continued

Under the heading of stone, miscellaneous, there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes all crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

Operator	Product	Address	Location of pit or quarry
Sonoma County—Continued			
Independent Gravel Co.	a	Forestville	Forestville
Mirabel Gravel Co., S. Cangros	a	222 3d St., San Rafael	Mirabel
Petaluma and Santa Rosa E. R. R., E. H. Maggard, Mgr.	b	Petaluma	Stony Point
J. P. Serres	a	Agua Caliente	Agua Caliente
Stony Point Quarry, W. A. Wilson	b	Petaluma, Star Rt.	Stony Point
Chas. Tracey	a	Sonoma	Sonoma
Stanislaus County			
Atlas Olympia Co.	a	209 Underwood Pldg., San Francisco	Orange Blossom
W. Haslan	a	Oakdale	Oakdale
Honeycutt & Co., H. Honeycutt	a	R. 4, Box 1626, Modesto	Modesto
Frank B. Marks	a, b	Newman	Crows Landing
W. S. McLean	d	1919 San Bruno Ave., San Francisco	Knights Ferry
Oakdale Irrigation Dist., M. E. Robinson, Auditor	a	Oakdale	Oakdale
Putman Sand & Gravel Co.	a	Modesto	Modesto
Rinehart Sand Pit, Rinehart Bros.	a	Modesto	Modesto
Service Bros. Gravel Plant	a, b	Waterford	Waterford
Tehama County			
Tehama County	a	Red Bluff	
Hemstreet & Bell	a	411 C St., Marysville	Paynes Creek
Trinity County			
Trinity County	a	Weaverville	
Roy Eastwood	a	Weaverville	Weaverville
U. S. Forest Service	a	Ferry Bldg., San Francisco	
Tulare County			
Tulare County	a, g	Visalia	
Duggan & Nelson	a	Porterville	Porterville
Visalia Transfer Co., Garland Sand Pit, G. A. Bigard	a	Visalia	Visalia
Porterville Cement Pipe Co.	a	P. O. Box 396, Porterville	Porterville
Jeffers Gravel Pit, O. C. Jeffers	a	520 Roche Ave., Porterville	Porterville

Supt. Sequoia Natl. Park	a, b	Three Rivers	Sequoia Natl. Park
Tulare Rock Co., O. Holliday	a, b	Lindsay	Lindsay
Tulare Cement Pipe Co., S. Oegeda	a	Tulare	Tulare
Tuolumne County			
Tuolumne County	b	Sonora	
McLean Quarry, W. S. McLean	d	1919 San Bruno Ave., San Francisco	Sonora
Bureau of Public Roads	b	461 Market St., San Francisco	
Ventura County			
El Rio Rock Co.	a, b	P. O. Box 381, Ventura	El Rio
Fillmore Rock Co.	a, b	Fillmore	Fillmore
Piru Rock Co.	a	Piru	Piru
Santa Clara Sand and Gravel Co.	a	2027 E. Main St., Ventura	Ventura
Santa Paula Rock Co.	a	Willard Bridge, Santa Paula	Santa Paula
Saticoy Rock Products Co.	a, b	Saticoy	Saticoy-Ventura
Ventura Velvet Molding Sand, Chas. A. Cole	c	1355 Church St., Ventura	Ventura
Yolo County			
Yolo County	a	Woodland	
Yolo Gravel Co.	a	P. O. Box 7, Yolo	Yolo
Yuba County			
Hemstreet & Bell	a, b	411 C St., Marysville	
Pacific Coast Aggregates, Inc.	a	85 2d St., San Francisco	Marysville

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag. f. Tube mill pebbles. g. Decomposed granite.

SULPHUR

Operator		Address	Location of mine
Colusa County			
Growers Chemical Co., H. C. Warwick, Supt.		Financial Center Bldg., San Francisco	Wilbur Springs

TUNGSTEN

Operator		Address	Location of mine
El Dorado County			
Comeback Cons. Tungsten Mine, B. F. Magee & Lee Wolfe	m	Georgetown	Placerville
Inyo County			
Round Valley Tungsten Co., Cooper Shapley	m	Bishop	Bishop
San Bernardino County			
Atolia Mining Co., A. V. Udell	s	1022 Crocker Bldg., San Francisco	Atolia
Tulare County			
Kennedy Tungsten Mine, J. H. Kennedy	m	Posey	Posey

m. Mined and made concentrates, but did not ship during the year. s. Shipped.

ZINC

Mine	Operator	Address	Location of mine
Spanish	Spanish Mining Co.	Crocker Bldg., San Francisco	Washington

APPENDIX

MINING BUREAU ACT

Chap. 679 [Stats. 1913]; amended, Chap. 280 [Stats. 1929.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

[Amendment approved May 14, 1929. In effect August 14, 1929.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the state of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage, special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and

library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information availble to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirty-first day of March, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof, shall be deposited at least once each month in the state treasury to the credit of the general fund except appropriations and moneys received under the provisions of an act entitled "An act establishing and creating a department of the state mining bureau for the protection of the natural resources of petroleum and gas from waste and destruction through improper operations in production; providing for the appointment of a state oil and gas supervisor; prescribing his duties and powers; fixing his compensation; providing for the appointment of deputies and employees; providing for their duties and compensation; providing for the inspection of petroleum and gas wells; requiring all persons operating petroleum and gas wells to make certain reports; providing procedure for arbitration of departmental rulings; creating a fund for the purpose of the act; providing for assessment of charges to be paid by operators and providing for the collection thereof; and making an appropriation for the purposes of this act." (Approved June 10, 1915, and all amendments thereto.)

The state controller is authorized to require financial reports from the state mining bureau or any officer thereof.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devises and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state minerologist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining

* Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau and to exchange publications with other geological surveys and scientific societies, etc.

SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

SEC. 16. For the purpose of this act and as used herein the term "mine" is hereby defined to embrace and include all mineral bearing properties of whatever kind or character whether underground, quarry, pit, well, spring or other source from which any mineral substance is or may be obtained, and the term "mineral" for the purposes of this act and whenever so used shall embrace and include any and all mineral products both metallic and nonmetallic, solid, liquid or gaseous, and mineral waters of whatever kind or character.

DEPARTMENT OF NATURAL RESOURCES ACT

Chap. 128 [Stats. 1927]; amended, Chap. 307 [Stats. 1929.]

An act to add a new article to chapter three of title one of part three of the Political Code to be numbered article two j, embracing sections three hundred seventy-three to three hundred seventy-three i, relating to a department of natural resources.

[Approved by the Governor April 13, 1927.]

[Amendment approved May 18, 1929.]

The people of the State of California do enact as follows:

SECTION 1. The Political Code is hereby amended by adding a new article to chapter III of title I of part III thereof, to be numbered article II*f*, embracing sections 373 to 373*i* and to read as follows:

ARTICLE II*j*.

DEPARTMENT OF NATURAL RESOURCES.

373. A department of the government of the State of California to be known as the department of natural resources is hereby created. The department shall be conducted under the control of an executive officer to be known as the director of natural resources, which office is hereby created. The director shall be appointed by and hold office at the pleasure of the governor and shall receive a salary of six thousand dollars per annum.

Except as in this article otherwise provided, the provisions of article II of this chapter, title, and part of the Political Code as adopted at the forty-fourth session of the Legislature and as the same may be amended from time to time, shall govern and apply to the conduct of the department of natural resources in every respect the same as if such provisions were herein set forth at length and wherever in said article II the term "head of the department" or similar designation occurs, the same shall for the purposes of this article mean the director of natural resources.

373*a*. For purposes of administration the department shall be forthwith organized by the director thereof, subject to the approval of the governor, in such manner as he shall deem necessary to properly segregate and conduct the work of the department, and the director shall have power to appoint, in accordance with the civil service and other provisions of law, such deputies, officers and other expert and clerical assistants as may be necessary. The work of the department is hereby divided into at least four divisions to be known as the division of forestry, the division of parks, the division of fish and game, and the division of mines.

373*b*. The division of mines shall be administered through a chief who shall be appointed by the director of natural resources upon the nomination of the state mining board, the chief to be a technically trained mining engineer and to be known as the state mineralogist; such chief shall receive a salary of six thousand dollars per annum. General policies for the guidance of the division of mines shall be determined by a board to be known as the state mining board, which shall consist of five members appointed by and to hold office at the pleasure of the governor.

373*c*. The division of forestry shall be administered through a chief of division who shall be known as the state forester, who shall be a technically trained forester, appointed by the director of natural resources upon nomination by the state board of forestry hereinafter provided. General policies for the guidance of the division of forestry shall be determined by a state board of forestry which shall consist of seven members appointed by and holding office at the pleasure of the governor. Of the seven members one shall be familiar with the pine timber industry, one with the redwood industry, one with the live stock industry, one with general agriculture and one with the problems of water conservation.

373*d*. The division of parks shall be administered through a chief of division who shall be appointed by the director of natural resources upon nomination by the state park commission hereinafter provided. General policies for the administration of the state park system shall be determined by the state park commission

which is hereby created to consist of five members appointed by the governor and holding office at his pleasure.

373*e*. The division of fish and game shall be administered through a fish and game commission consisting of three members appointed by and holding office at the pleasure of the governor.

373*f*. The chiefs of the divisions of forestry and parks respectively shall receive such salaries as may be determined by the director with the approval of the governor. The director of natural resources and the chief of each division before entering upon his duties shall execute to the State of California an official bond in the penal sum of twenty-five thousand dollars conditioned upon the faithful performance of his duties. The members of the board of forestry, the state parks commission and fish and game commission shall serve without compensation, but shall be entitled to their actual expenses incurred in the performance of their duties.

373*g*. The department of natural resources shall succeed to and is hereby invested with all the duties, powers, purposes, responsibilities and jurisdiction of the state mining bureau, state mineralogist, department of petroleum and gas, state oil and gas supervisor, state forester, state board of forestry, California redwood park commission, San Pasqual battlefield commission, Mount Diablo park commission, state fish and game commission, state fish and game commissioners, and, except as herein otherwisee provided, of the several officers, deputies and employees of such bodies and offices, and whenever by the provisions of any statute or law now in force or that may hereafter be enacted a duty or jurisdiction is imposed or authority conferred upon any of said officers, offices, bodies, deputies or employees by any statute the enforcement of which is transferred to the department, such duty, jurisdiction and authority are hereby imposed upon and transferred to the department of natural resources and the appropriate officers thereof with the same force and effect as though the title of said department of natural resources had been specifically set forth and named therein in lieu of the name of any such body, office, officer, deputy or employee. Said bodies and offices, the duties, powers, purposes, responsibilities and jurisdiction of which are so transferred and vested in the department of natural resources, and the positions of all officers, deputies and employees thereunder, are and each of them is hereby abolished and shall have no further legal existence, but the statutes and laws under which they existed and all laws prescribing their duties, powers, purposes, responsibilities and jurisdiction, together with all lawful rules and regulations established thereunder are hereby expressly continued in force.

The department of natural resources shall be in possession and control of all records, books, papers, offices, equipment, supplies, moneys, funds, appropriations, land and other property real or personal now or hereafter held for the benefit or use of said bodies, offices and officers.

The boards of district oil and gas commissioners, the offices of district oil and gas commissioners and the board of review, correction and equalization created by the act approved June 10, 1915, establishing the department of petroleum and gas, are hereby respectively continued in force wiith the powers, duties, responsibilities and jurisdiction in them vested by the provisions of said act approved June 10, 1915, as amended; *provided*, that said board of review shall consist of the director of natural resources, the director of finance and the chairman of the state board of equalization.

373*h*. The management and control of the property acquired by the State of California under or pursuant to the provisions of the act entitled "An act to accept the gift to the state of San Pasqual battlefield in San Diego county, to provide for collecting and systematizing the history of said battle, for determining the exact location thereof, and to report a suitable method of marking said battlefield and commemorating the heroism of those Americans who fought and died there," approved May 11, 1919, is hereby transferred to and vested in the department of natural resources.

373*i*. From and after the date upon which this act takes effect, the department of natural resources shall be and is hereby authorized and empowered to expend the moneys in any appropriation or in any special fund in the state treasury now remaining or made available by law for the administration of the provisions of all the statutes the administration of which is committed to the department, or for the use, support, or maintenance of any board, bureau, commission, department, office or officer whose duties, powers, and functions are, by the provisions of this article, transferred to and conferred upon the department of natural resources. Such expenditures by the department shall be made in accordance with law in carrying out the purposes for which such appropriations were made or such special funds created.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-one years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the office of the Division of Mines, in the Ferry Building, San Francisco; Bankers Building, Los Angeles; State Office Building, Sacramento; Redding; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early reports and bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
**Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	----
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	----
**Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	----
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65
**Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	----
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917: A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----
Chapters of the State Mineralogist's Report, Biennial Period 1917–1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, **March, **April, **May, **June, July, August, September, October, **November, December, 1922	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25
October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	.25
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25
July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25
October, 1927, Mines and Mineral Resources of Mono County	.25
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:	
January, 1928, Mines and Mineral Resources of Tuolumne County	.25
April, 1928, Mines and Mineral Resources of Mariposa County	.25
**July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	----
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	.25
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25
Chapters of Twenty-sixth Report of the State Mineralogist 'Mining in California,' Walter W. Bradley. Published quarterly:	
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25

REPORTS—Continued

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April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California $0.25

July, 19 0, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California ..... .25

October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary) .25

Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California', Walter W. Bradley. Published quarterly:

January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative effects in Concrete ..... .25

April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifer of the Kreyenhagen Shale. Geology of Santa Cruz Island ..... .25

July, 1931, Mines and Mineral Resources of Yuba and San Bernardino Counties, Feldspar, Silica, Andalusite, and Cyanite Deposits of California. Andalusite in Mono County. Trinity-Klamath River Fish and Game District affects Mining. U. S. Mint Aids Prospectors ..... .25

October, 1931, Mines and Mineral Resources of Alpine County. Geology of San Jacinto Quadrangle South of San Gorgonio Pass. Mining Activity in Inyo and Mono Counties ..... .25

Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:

January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley, Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite ..... .25

April, Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining ..... .25

July-October (Ventura), Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist. (In Press) ..... .50

Subscription, $1.00 in advance (by calendar year, only).

Chapters of State Oil and Gas Supervisor's Report:

Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume) ..... Free

Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:

**April, **May, June, **July, **August, **September, **October, November, **December, 1919 ..... Free

January, February, March, April, **May, June, July, **August, September, October, November, December, 1920 ..... Free

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January, February, March, April, May, June, July-August-September, October-November-December, 1929 ..... Free

January-February-March, April-May-June, July-August-September, 1930 .. Free
(Published quarterly beginning July, 1929.)

BULLETINS

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Price

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations ----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations ----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps ----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.) ----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations ----
**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations ----
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations ----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp. ----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations ----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale ----
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**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations ----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations ----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps ----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899 ----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet ----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet ----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps $0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps ----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet ----
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**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903. 273 pp., 144 illustrations, 8 maps ----
**Bulletin No. 28. Mineral Production of California for 1902, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet ----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp. ----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet ----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904. 230 pp., 116 illustrations, 14 maps ----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet ----

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Price

**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet ----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904. 55 pp., 20 county maps. Relief map of California ----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905. 120 pp., 66 illustrations, 3 maps ----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations ----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map ----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet ----
**Bulletin No. 41. Mines and Minerals of California for 1904, by Charles G. Yale. 1905. 54 pp., 20 county maps ----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet ----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps ----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp. ----
**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp. ----
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet ----
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**Map of California, Showing Mineral Deposits (50 x 60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
**Map of Madera County, Showing Boundaries, National Forests	----
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Map No. 41	—Potrero, Los Angeles County	.75
Map No. 42	—Playa Del Rey, Los Angeles County	.75

DETERMINATION OF MINERAL SAMPLES

Samples (limited to three at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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